

APOLLO

# Biology

## HL Answers

First assessment 2025

Whole questions arranged by syllabus topic.

Original question and scheme crops preserve source diagrams.

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# Water

6 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q1 | 1 marks

1.       B  

Biology HL | Paper 1A | May 2025 TZ2 | Q1 | 1 marks

1.       D  

Biology HL | Paper 1A | May 2025 TZ3 | Q1 | 1 marks

1.       C

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                |          |
|----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 2. | a | <p>a. water has greater viscosity than air;</p> <p>b. thermal conductivity is higher in water than in air;</p> <p>c. specific heat capacity is higher in water than in air;</p> <p>d. water is denser/has more buoyancy than air;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><i>The physical property must be named. Comparative terms are expected, making reference to both eg: accept higher in water, but not high in water.</i></p> <p><i>Accept the converse of any of the marking points.</i></p> | 2<br>max |
| 2. | b | <p>a. front limbs/flippers/legs are used for steering/to paddle/propel through the water <b>OR</b><br/>tail forms a fluke with up-and-down movement / tail adapted to propel in water;</p> <p>b. (covered in) blubber/thick layer of fat to insulate from cold / increase buoyancy<br/><b>OR</b><br/>water-proof fur for insulation;</p> <p>c. can hold their breath (for many/45 minutes/long periods) to dive under water<br/><b>OR</b><br/>airways changed to allow periodic breathing between dives<br/><b>OR</b><br/>no connection between mouth and lungs / closing of nostrils to avoid water entering the lungs<br/><b>OR</b><br/>uses claws on their (fore/front) flippers/limbs/legs to make a breathing hole in ice;</p> <p>d. more/increased blood (volume)/red blood cells/haemoglobin/myoglobin concentration for more oxygen storage;</p> <p>e. streamlined (body) to minimize resistance/friction (when swimming);</p> |                                                                                                                                                                                                                                | 2<br>max |
| 2. | c | primary consumer;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                | 1<br>max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ3 | Q2 | 1 marks

2.       C  

Biology HL | Paper 1A | Specimen 2025 | Q1 | 1 marks

1.       B

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# Nucleic acids

8 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ2 | Q2 | 1 marks

2.       A  

Biology HL | Paper 1A | May 2025 TZ3 | Q2 | 1 marks

2.       B  

Biology HL | Paper 1A | May 2025 TZ3 | Q9 | 1 marks

9.       A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q2 | 1 marks

2.       A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q9 | 1 marks

9.       A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q1 | 1 marks

1.       D  

Biology HL | Paper 1A | Specimen 2025 | Q20 | 1 marks

20.       D

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |   |
|----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 4. | a | adenine/guanine                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 1 |
| 4. | b | a. the only ratios that are 1:1 are between A:T and C:G;<br>b. ratios of A:G and T:C are not 1:1 in any of the experimental organisms;                                                                                                                                                                                                                                                                                                                   |  | 2 |
| 4. | c | overall ratio of purines:pyrimidines in all experimental organisms is 1:1 but yeast G:C ratios represent an anomaly                                                                                                                                                                                                                                                                                                                                      |  | 1 |
| 4. | d | a. same four bases found across a variety of organisms;<br>b. pattern of ratios in the data is common / comparable across the organisms shown<br><b>OR</b><br>same complementary base pairing;<br>c. this suggests a common ancestor;                                                                                                                                                                                                                    |  | 2 |
| 4. | e | <i>Evidence for a relationship</i><br>a. eukaryote genomes (tend to be) larger than prokaryote genomes;<br>b. most DNA sequences in higher eukaryotic genomes are non-coding;<br>c. introns occur within eukaryotic genes;<br><i>Evidence against a relationship</i><br>d. no relationship between genome size and complexity within the eukaryotes;<br>e. example given; e.g. <i>Amoeba proteus</i> genome 100x larger than <i>Homo sapiens</i> genome; |  | 4 |

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# Origins of cells

3 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q2 | 1 marks

2.       A  

Biology HL | Paper 1A | May 2025 TZ1 | Q12 | 1 marks

12.      B  

Biology HL | Paper 1A | Specimen 2025 | Q13 | 1 marks

13.      B

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# Cell structure

4 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ2 | Q12 | 1 marks

12.       C  

Biology HL | Paper 1A | May 2025 TZ3 | Q12 | 1 marks

12.       C

|    |   |    |                                                       |                                                                                                                                                  |   |
|----|---|----|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 1. | a |    | (eyepiece) graticule;                                 |                                                                                                                                                  | 1 |
| 1. | b | i  | 42.5 $\mu\text{m}$<br><b>OR</b><br>45 $\mu\text{m}$ ; | Accept any value within the range:<br>42 to 45 $\mu\text{m}$ ;<br>Unit required.                                                                 | 1 |
| 1. | b | ii | 1000 $\pm$ 200 (x);                                   | Accept any value within the range 800 to 1200.<br>Allow ECF, but working must be shown and it must be around 45 mm divided by the result of 1bi. | 1 |

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| Question |   |  | Answers                                                                                                                                                                           | Notes                                                                                                                                                                                     | Total    |
|----------|---|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1.       | c |  | a. Y/(mitochondrion) releases ATP/carries out aerobic/cellular respiration;<br>b. Z/(Golgi apparatus) packages/modifies proteins/carbohydrates/lipids / makes lysosomes/vesicles; | a. Accept produces ATP / Krebs cycle.<br>Accept correct function for Y/Z, even if incorrect organelle name is given.<br>Do not accept packages substances/molecules/products – too vague. | 2<br>max |

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Total        |
|----------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1.       | d | <p><b>Similarities: [2 max]</b></p> <p>a. in both lambda attaches to bacterial/host cell;</p> <p>b. both insert DNA into the bacterial/host cell</p> <p><b>OR</b></p> <p>both infect the bacterial/host cell;</p> <p>c. both use the bacterial/host cell (pathways) to replicate their DNA;</p> <p><b>Differences [2 max]</b></p> <p>d. in lytic (cycle), the viral DNA is replicated independently/remains separate from the bacterial/host DNA <b>AND</b> in lysogenic (cycle), the viral DNA integrates with the bacterial/host DNA;</p> <p>e. in lytic viral/virion assembly occurs <b>AND</b> in lysogenic it is delayed/dormant;</p> <p>f. in lytic, the bacterial/host cell is then destroyed/bursts/lysed <b>AND</b> in lysogenic it is delayed/not destroyed;</p> | <p><i>Do not accept answers referring to RNA, genome or genetic material instead of DNA.</i></p> <p><i>Use ECF for continued use of the above terms.</i></p> <p><i>a. Do not accept that both cause cells to burst/die.</i></p> <p><i>b. Do not accept insertion of virus into host cell.</i></p> <p><i>c. Do not accept that the virus reproduces, it needs to be viral DNA replication.</i></p> <p><i>Accept statements saying 'only' as implying that the other cycle is the opposite.</i></p> | <b>3 max</b> |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |    |                                                                                                                   |  |   |
|----|---|----|-------------------------------------------------------------------------------------------------------------------|--|---|
| 2. | a |    | a. nucleus;<br>b. mitochondria;<br>c. Golgi apparatus;<br>d. ER/rough ER;<br>e. smooth ER;<br>f. vacuole/vesicle; |  | 2 |
| 2. | b | i  | a. chloroplasts;<br>b. large/central vacuole;                                                                     |  | 1 |
| 2. | b | ii | a. plasma membrane;<br>b. ribosomes;                                                                              |  | 1 |

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# Viruses

8 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ2 | Q13 | 1 marks

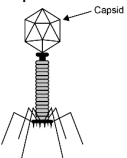
13.       D  

Biology HL | Paper 1A | May 2025 TZ3 | Q13 | 1 marks

13.       D  

Biology HL | Paper 1A | May 2025 TZ3 | Q28 | 1 marks

28.       D

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |          |
|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------|
| 4. | a | <p>capsid labelled;</p>  <p>[Source: ALI DAMOUH/SCIENCE PHOTO LIBRARY, 2024. <i>Bacteriophage, illustration.</i> [image online] Available at: <a href="https://www.gettyimages.co.uk/detail/illustration/bacteriophage-illustration-royalty-free-illustration/2080360644?ad_ppopup=true">https://www.gettyimages.co.uk/detail/illustration/bacteriophage-illustration-royalty-free-illustration/2080360644?ad_ppopup=true</a> [Accessed 29 July 2024]. Source adapted.]</p> |  | 1        |
| 4. | b | <p>a. (viruses) do not have a metabolism of their own (rely on a host cell for chemical processes) / cannot carry out transcription/protein synthesis / cannot perform ATP synthesis;</p> <p>b. they are not made of cells (but consist only of a nucleic acid core and protein coat/capsid);</p> <p>c. they do not carry out all reproduction but only multiply inside other living cells;</p>                                                                                                                                                              |  | 1<br>max |
| 4. | c | <p>a. the virus attaches to maltoporin/protein in the host/bacterium membrane;</p> <p>b. the viral DNA/genome is integrated into a host/bacterium;</p> <p>c. when the host DNA replicates/does mitosis, viral DNA is also replicated;</p> <p>d. all daughter cells contain viral DNA/genetic material;</p> <p>e. the inserted DNA is known as a prophage;</p> <p>f. bacteriophage/prophage remains in dormant state in host/bacterium</p> <p><b>OR</b></p> <p>later prophage may exit to initiate <u>lytic</u> cycle;</p>                                    |  | 3<br>max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q12 | 1 marks

12.       A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q13 | 1 marks

13.       A

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 7. | a | <p>a. four bases in DNA / bases in DNA are adenine cytosine guanine and thymine<br/><b>OR</b><br/>four bases in RNA / bases in RNA are adenine cytosine guanine and uracil;</p> <p>b. purines and pyrimidines<br/><b>OR</b><br/>uracil instead of thymine in RNA;</p> <p>c. bases/nucleotides can be arranged in any sequence;</p> <p>d. many/<math>4^n</math> possible permutations/combinations/sequences (of the four bases)<br/><b>OR</b><br/>64 possible triplets of bases/codons;</p> <p>e. nucleic acids/RNA/DNA can have any number of nucleotides / unlimited in length;</p> <p>f. mutations can change base sequence/increase diversity;</p> <p>g. many different proteins/proteins so many sequences needed to code for them;</p> <p>h. three/triplet of bases needed to code for each amino acid<br/><b>OR</b><br/>degeneracy of genetic code/more than one codon per amino acid;</p> | <p><i>Award mark point a and mark point b if the answer includes the four bases in both DNA and RNA.</i></p> <p><i>Do not accept letters instead of base names in mark point a.</i></p> <p><i>Mark points d and g are different: mark point d is for the idea that the four bases in any sequence gives many possible base sequences; mark point g is for the idea that the many different proteins necessitate many different base sequences in the genome.</i></p> | 4<br>max |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Notes                                                                                                                                                                                                                                                                                                                                         | Total    |
|----------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 7.       | b | <p>a. variation in size/shape</p> <p><b>OR</b></p> <p>helical versus spherical / spikes versus no spikes / other contrasting shapes;</p> <p>b. head and tail in bacteriophage (lambda) and polyhedral/spherical in HIV/COVID-19;</p> <p>c. DNA or RNA as genetic material;</p> <p>d. retroviruses/HIV has reverse transcriptase (but other viruses do not);</p> <p>e. DNA in bacteriophage lambda and RNA in HIV/COVID-19;</p> <p>f. single-stranded or double stranded DNA/RNA/nucleic acid;</p> <p>g. bacteriophage lambda with double stranded and HIV/COVID-19 with single stranded;</p> <p>h. circular or linear DNA / linear DNA in bacteriophage lambda;</p> <p>i. variation in number of DNA/RNA/nucleic acid molecules</p> <p><b>OR</b></p> <p>HIV/other virus example with more than one molecule (of DNA/RNA);</p> <p>j. some viruses are enveloped (in plasma membrane from the host cell);</p> <p>k. bacteriophage lambda is a naked virus and HIV/COVID-19 is enveloped;</p> <p>l. rapid evolution due to short generation time/rapid mutation rate/no proofreading/intense natural selection;</p> <p>m. changes in influenza coat proteins/coronavirus spike proteins;</p> | <p><i>Accept other verified and valid examples in marking points b, e, g, i, k and m.</i></p> <p><i>Accept coronavirus instead of COVID-19.</i></p> <p><i>Accept diagrams to show examples of structural differences for marking points b, e, g, i, k and m.</i></p> <p><i>Reject statements that some viruses have plasma membranes.</i></p> | 7<br>max |

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Notes                                                                                                                                             | Total                   |
|----------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 7.       | c | <p>a. fusion of chromosomes (decreases chromosome number);</p> <p>b. chromosomes 12 and 13 in chimpanzees equivalent to human chromosome 2</p> <p><b>OR</b></p> <p>fewer chromosomes in humans than chimpanzees / 46 in humans and 48 in chimpanzees;</p> <p>c. fission/breaks in/splitting of chromosomes increases chromosome number;</p> <p>d. doubling of chromosome number by polyploidy/in tetraploids;</p> <p>e. non-disjunction of all bivalents/chromosomes in meiosis</p> <p><b>OR</b></p> <p>DNA replication without cytokinesis;</p> <p>f. example of polyploidy in knotweeds/smartweeds/<i>Persicaria/Allium</i>/other verified example;</p> <p>g. changes in chromosome number/polyploidy can cause speciation</p> <p><b>OR</b></p> <p>chromosome number can change following speciation;</p> | <p><i>d. do not allow types of polyploidy that result in infertility such as triploidy.</i></p> <p><i>e. Do not allow aneuploidy/trisomy.</i></p> | <p><b>4<br/>max</b></p> |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q14 | 1 marks

14.     A

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# Diversity of organisms

3 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q13 | 1 marks

13.       C  

Biology HL | Paper 1A | May 2025 TZ3 | Q34 | 1 marks

34.       A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q35 | 1 marks

35.       D

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# Classification and cladistics

10 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q21 | 1 marks

21.        C

Biology HL | Paper 1A | May 2025 TZ2 | Q22 | 1 marks

22.        B

Biology HL | Paper 1A | May 2025 TZ3 | Q22 | 1 marks

22.        C

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                         |              |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|--------------|
| 9. | a | <p>a. (homologous structures are) similar features/structures/anatomy that can have different functions;</p> <p>b. (homologies are) result of divergent evolution/adaptive radiation</p> <p><b>OR</b></p> <p>(homologies are) result of different selection pressures/natural selection;</p> <p>c. (organisms evolve) from a common ancestor / show evolutionary relationships;</p> <p>d. can be seen in ancient organism remains / fossils;</p> <p>e. can be seen in similarities among organism limbs/structures/vestigial organs/embryos/DNA alive today;</p> <p>f. an example of homologous structures are pentadactyl limbs;</p>                                                                                                               |                                         | <b>4 max</b> |
| 9. | b | <p><i>conditions [2 max]:</i></p> <p>a. no mutation;</p> <p>b. random mating;</p> <p>c. no migration / gene flow;</p> <p>d. large population size / no genetic drift;</p> <p>e. no selection / (natural) selection does not favour one phenotype</p> <p><i>use [2 max]:</i></p> <p>f. p and q denote the two allele frequencies;</p> <p><b>OR</b></p> <p>p denotes frequency of dominant allele <u>and</u> q denotes frequency of recessive allele;</p> <p>g. p and q add up to 1 / <math>p + q = 1</math>;</p> <p>h. <math>p^2 + 2pq + q^2 = 1</math>;</p> <p>i. the frequency of the 2 homozygous genotypes are <math>p^2</math> and <math>q^2</math></p> <p><b>OR</b></p> <p>the frequency of the heterozygous genotype is <math>2pq</math>;</p> | Max 2 for conditions and Max 2 for use. | <b>3 max</b> |

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| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Notes                                                       | Total |
|----------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-------|
| 9.       | c | <p>a. classification needed because of immense diversity of species/further study is facilitated/helps in identification of species;</p> <p>b. (ideal) classification follows/is based on evolutionary relationships (between species that have a common ancestor);</p> <p>c. (classification based on evolutionary relationships) allows characteristics of organisms within a group to be predicted because they are shared;</p> <p>d. relationships can be inferred using different kinds of evidence such as morphology/development/molecular markers/presence/absence of genes/DNA/RNA/protein/amino acid sequences;</p> <p>e. organisms that share similar structures/genetic sequences/DNA/RNA tend to be more closely related;</p> <p>f. differences in (DNA/amino acid) sequence are due to mutation;</p> <p>g. cladograms are branching diagrams/trees connected to a common ancestor<br/><b>OR</b><br/>the branches (in a cladogram) represent the evolutionary path of a group of organisms from a common ancestor;</p> <p>h. <u>cladograms</u> are based on phylogeny/evolutionary relationships<br/><b>OR</b><br/><u>cladograms</u> are built from multiple sequence alignments/ base sequences of genes / base sequences of amino acids in proteins;</p> <p><b>Marking points for 9c continued on next page....</b></p> | <p><i>g. can be awarded through a labelled diagram.</i></p> | 8 max |

Question 9c continued....

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                           |  |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--|
| 9. | c | <p>i. a clade is a group of organisms that have evolved from a common ancestor<br/><b>OR</b><br/>a clade includes a single common ancestor and all of its descendants/all species evolved from it;</p> <p>j. the <u>root</u> is the base of the cladogram / the hypothetical common ancestor <u>of all the clades</u>;</p> <p>k. the <u>node</u> of the branch shows the most recent common ancestor between two species of a clade<br/><b>OR</b><br/>the <u>node</u> represents a (hypothetical) common ancestor<br/><b>OR</b><br/>the <u>node</u> is a branching point indicating that a group of organisms are related;</p> <p>l. the <u>terminal branches</u> are ends that represent individual clades / species / group of closely related species;</p> | <p><i>j, k. and l. can be awarded in a clearly annotated diagram.</i></p> |  |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--|

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                               |       |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------|
| 7. | a | <p>a. root is the (last/initial) common ancestor of all the organisms / earliest ancestor (in the cladogram);</p> <p>b. node represents the most recent common ancestor (of two species/two clades)</p> <p><b>OR</b></p> <p>node is a branching point indicating that a group of organisms are related</p> <p><b>OR</b></p> <p>node is a point where species/clades branch off;</p>                                                                                                                                             | <p><i>a. It must be clear that all of the organisms/clades in the cladogram came / evolved / descended from the root.</i></p> | 2     |
| 7. | b | <p>a. mutations change base sequence of DNA;</p> <p>b. changes to DNA/base sequence cause changes to amino acid sequence;</p> <p>c. sequence differences accumulate (gradually/slowly) over time;</p> <p>d. species with more differences in amino acid sequences diverged longer ago / fewer differences means more recent divergence from a common ancestor;</p> <p>e. more objective than using morphology/physical traits / <i>OWTTE</i>;</p> <p>f. species with similar amino acid sequences are more closely related;</p> |                                                                                                                               | 3 max |
| 7. | c | <p>a. base sequence of genes / DNA (base) sequences</p> <p><b>OR</b></p> <p>base sequence of rRNA</p> <p><b>OR</b></p> <p>comparing karyotypes;</p> <p>b. morphological/physical/anatomical/homologous traits/characteristics / specific example of morphology/homology that could be used;</p>                                                                                                                                                                                                                                 |                                                                                                                               | 1 max |

| Question |   | Answers                                                                                                                                                                           | Notes | Total |
|----------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 7.       | d | <p>a. choose the simplest explanation for observations;</p> <p>b. choose the cladogram that requires the smallest number of sequence/genetic/ trait changes/fewest mutations;</p> |       | 1 max |

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q21 | 1 marks

21.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q22 | 1 marks

22.          D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q21 | 1 marks

21.          A  

Biology HL | Paper 1A | Specimen 2025 | Q24 | 1 marks

24.          C  

Biology HL | Paper 1A | Specimen 2025 | Q25 | 1 marks

25.          D

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# Evolution and speciation

12 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q33 | 1 marks

33.        B

Biology HL | Paper 1A | May 2025 TZ2 | Q21 | 1 marks

21.        A

Biology HL | Paper 1A | May 2025 TZ2 | Q33 | 1 marks

33.        C

Biology HL | Paper 1A | May 2025 TZ2 | Q34 | 1 marks

34.        A

Biology HL | Paper 1A | May 2025 TZ3 | Q21 | 1 marks

21.        C

Biology HL | Paper 1A | May 2025 TZ3 | Q33 | 1 marks

33.        A

|    |   |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                            |       |
|----|---|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------|
| 1. | a |  | 3 / three;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Accept Pan, Gorilla, Pongo | 1     |
| 1. | b |  | (No)<br>a. the data only shows the two amino acids that differ between <u>humans</u> and <i>P. paniscus</i> or <i>G. gorilla</i> (in the FOXP2 protein);<br>b. the data only shows the comparison of one <u>protein</u> ;<br>c. <i>P. paniscus</i> and <i>G. gorilla</i> protein could have more/fewer/other amino acids that differ (between them)<br><b>OR</b><br>the specific amino acid differences are unknown;                                                                                                                                                                                                                                                                                                                                                                           |                            | 2 max |
| 1. | c |  | a. length / size of chromosome 2 in humans and 12+13 in chimpanzees is approximately equal<br><b>OR</b><br>size of the human chromosome 2 is larger than either chromosomes 12 or 13;<br>b. (bands/banding) patterns/(DNA) sequences on chromosomes 12 and 13 match chromosome 2;<br>c. centromere sequences present in chromosome 2 where there is no centromere<br><b>OR</b><br>chromosome 2 has an additional centromere sequence (within the chromosome);<br>d. telomere sequence present in chromosome 2 where there is no telomere<br><b>OR</b><br>chromosome 2 has an additional telomere sequence (within the chromosome);<br>e. presence of telomere sequences at the predicted fusion point in human chromosome 2;<br>f. chromosome 12 is inverted in the short arm of chromosome 2; |                            | 4 max |

– 5 –

2225 – 6020

| Question |   |    | Answers                                                                                                                                        | Notes                           | Total |
|----------|---|----|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------|
| 1.       | d | i  | small/fixed size;<br>nucleic acid/DNA/RNA;<br><u>capsid</u> (made from protein);<br>no cytoplasm;<br>few or no enzymes;<br>attachment protein; | Do not accept genetic material. | 1 max |
| 1.       | d | ii | zoonosis/zoonoses/zoonotic;                                                                                                                    |                                 | 1     |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |  |                                                                                                                                                                                                                                                                                                            |  |                      |
|----|---|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------|
| 7. | c |  | <div>a. loss of habitat/breeding grounds leads to less reproductive success/lower survival/valid example;<br/>b. loss of food sources/resources leads to increased hunger/starvation/lower energy/valid example;<br/>c. loss of shelter leads to increased predation/lower protection/valid example;</div> |  | <div>2<br/>max</div> |
|----|---|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q33 | 1 marks

33.          A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q33 | 1 marks

33.          A  

Biology HL | Paper 1A | Specimen 2025 | Q32 | 1 marks

32.          C  

Biology HL | Paper 1A | Specimen 2025 | Q33 | 1 marks

33.          D

APOLLO

# Conservation of biodiversity

4 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q34 | 1 marks

34.          D  

Biology HL | Paper 1A | May 2025 TZ3 | Q38 | 1 marks

38.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q34 | 1 marks

34.          D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q34 | 1 marks

34.          A

APOLLO

# Carbohydrates and lipids

7 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q3 | 1 marks

3.       A  

Biology HL | Paper 1A | May 2025 TZ2 | Q3 | 1 marks

3.       A  

Biology HL | Paper 1A | May 2025 TZ3 | Q3 | 1 marks

3.       A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q3 | 1 marks

3.       B

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                              |          |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 8. | a | <p>a. monosaccharides/disaccharides/sugars are soluble (in water/blood/plasma/sap)</p> <p><b>OR</b></p> <p>monosaccharides/disaccharides/sugars can be transported (in blood/plasma/sap);</p> <p>b. glucose is used for (aerobic) respiration</p> <p><b>OR</b></p> <p>glucose releases/yields energy during respiration/when oxidized;</p> <p>c. can be polymerized / form polymers/macromolecules/long chains by <u>condensation</u>;</p> <p>d. starch/glycogen is a polymer containing/is made of many (alpha) glucose (molecules);</p> <p>e. starch consists of amylose and amylopectin</p> <p><b>OR</b></p> <p>amylose is unbranched / amylopectin is branched / glycogen is (more) branched;</p> <p>f. glycogen/starch (is branched so) can be hydrolyzed to release (alpha) glucose quickly/easily/when needed;</p> <p>g. starch/glycogen are used as energy stores;</p> <p><b>Marking point for 8a continued on next page...</b></p> | <p><i>For a. accept named sugars</i></p> <p><i>For b. accept other sugars.</i></p> <p><i>For d. accept <math>\alpha</math>.</i></p> <p><i>For g. energy is required.</i></p> | 7<br>max |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|

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8825 – 6021M

## 8a continued..

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                           |  |
|----|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 8. | a | <p>h. (coiling of starch) makes it compact so that lots of (alpha) glucose can be stored in a small volume;</p> <p>i. starch/glycogen are insoluble (due to large molecular size) so do not affect the water/solute/pressure potential inside a cell</p> <p><b>OR</b></p> <p>glucose would cause osmotic problems if stored in cells;</p> <p>j. cellulose is a (beta) glucose polymer / is made of many (beta) glucose (molecules);</p> <p>k. cellulose consists of alternating orientation of (beta) glucose monomers / the glucose subunits in the chain face alternately upwards and downwards;</p> <p>l. (different) cellulose chains are crosslinked (by hydrogen bonds) to form bundles;</p> <p>m. cellulose has a structural role / supports / forms the cell wall (in plants);</p> <p>n. cellulose is insoluble / has high tensile strength / prevents plant cells from bursting (when water enters by osmosis);</p> | <p><i>For h. accept references to 'area,' 'space' or 'density'.</i></p> <p><i>For j. accept <math>\beta</math>.</i></p> <p><i>For k. accept drawings.</i></p> <p><i>For l. accept 'microfibrils'.</i></p> |  |
|----|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 8. b     | a. movement of cells/chromosomes <b>and</b> example of movement;<br>b. movement of flagellum/cilium;<br>c. endocytosis/exocytosis;<br>d. detachment of myosin heads from actin filaments / myosin heads change their angle/become cocked;<br>e. active transport <b>and</b> example of use of active transport;<br>f. anabolic reactions / polymerization example / example of synthesizing macromolecules;<br>g. generation of heat <b>and</b> to provide optimum temperature for enzyme activity / in homeostasis / to maintain body temperature;<br>h. phosphorylation of substrates in glycolysis;<br>i. phosphorylation of substrates in photosynthesis light-independent reaction/Calvin cycle; | <i>For a. accept descriptions of cells (e.g. amoeboid phagocyte moving to site of infection) or chromosomes (e.g. anaphase, chromosomes moving to opposite poles).</i><br><br><i>For d. ignore 'muscle contraction'.</i><br><br><i>For e. E.g. sodium-potassium pump (in neurons) / maintaining resting potential in neurons / generation of root pressure / villus epithelial cells / selective reabsorption in kidney.</i><br><br><i>For e. do not accept transport of large molecules as example.</i><br><br><i>For f. accept examples such as DNA replication / transcription / translation / and other examples of formation of macromolecules.</i><br><br><i>For h. accept phosphorylation of glucose (to glucose-6-phosphate) or phosphorylation of fructose-6-phosphate (to fructose 1,6-biphosphate).</i><br><br><i>For i. accept formation of triose phosphate and formation of ribulose biphosphate (regeneration of RuBP).</i> | 5 max |

| Question |   |  | Answers                                          | Notes                                                                 | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
|----------|---|--|--------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 8.       | c |  |                                                  |                                                                       | Accept $\text{NAD}^+$ and $\text{NADP}^+$<br><br>For c. accept PSI / PSII / ETC / chemiosmosis for photophosphorylation in photosynthesis.<br><br>For d. accept ETC / chemiosmosis or oxidative phosphorylation in aerobic respiration<br><br>For d. accept named stages of the Calvin cycle<br><br>A table is not required. Accept separate paragraphs about respiration and photosynthesis as long as <b>both</b> parts of the marking point are stated. | 3<br>max |
|          |   |  | Reduced hydrogen carriers in AEROBIC RESPIRATION | Reduced hydrogen carriers in PHOTOSYNTHESIS                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |
|          |   |  | a. found in cytoplasm/mitochondria               | found in chloroplasts;                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |
|          |   |  | b. reduced NAD/NADH involved                     | reduced NADP/NADPH involved;                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |
|          |   |  | c. made in glycolysis/ link reaction/Krebs cycle | made in light dependent reactions/ (non-cyclic) photophosphorylation; |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |
|          |   |  | d. required for oxidative phosphorylation        | required for light-independent reactions/Calvin cycle;                |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q4 | 1 marks

4.       B  

Biology HL | Paper 1A | Specimen 2025 | Q5 | 1 marks

5.       B

APOLLO

# Proteins

6 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q4 | 1 marks

4.       C  

Biology HL | Paper 1A | May 2025 TZ2 | Q4 | 1 marks

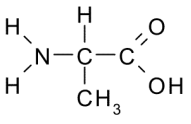
4.       B  

Biology HL | Paper 1A | May 2025 TZ3 | Q4 | 1 marks

4.       B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q3 | 1 marks

3.       D

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                               |       |
|----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2. | a | <p>a. essential amino acids cannot be synthesized (by human cells)</p> <p><b>OR</b></p> <p>essential amino acids are required to be obtained by diet / OWTTE;</p> <p>b. non-essential amino acids can be made (from other amino acids);</p>                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                               | 2     |
| 2. | b | <p>a.  / NH<sub>2</sub> / amine group shown as N with two single bonds to H / as NH<sub>2</sub> and bonded to C;</p> <p>b.  / carboxyl group shown as C with single bond to OH and double bond to O / as COOH and bonded to C;</p> <p>c.  / H and R linked by single bonds to the same C as carboxyl and amine groups;</p> | <p>Allow a specific amino acid R-group in marking point c, such as CH<sub>3</sub> (in alanine).</p>        | 3 max |
| 2. | c | <p>hydrogen bonds;</p> <p>ionic bonds;</p> <p><u>disulfide</u> bridges/<u>disulfide</u> (covalent) bonds;</p> <p>hydrophobic interactions;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>Mark the first two answers only.</p> <p>Do not allow 'interactions' instead of 'bonds'</p> <p>Do not allow 'bonds' instead of 'interactions'</p> <p>Do not allow van der Waals forces.</p> | 2 max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q6 | 1 marks

6.     A

APOLLO

# Membranes and membrane transport

10 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ2 | Q14 | 1 marks

14.       A  

Biology HL | Paper 1A | May 2025 TZ2 | Q15 | 1 marks

15.       B  

Biology HL | Paper 1A | May 2025 TZ3 | Q14 | 1 marks

14.       A

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                     |       |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|-------|
| 9. | a | <p>a. (membranes divide the cell into) <u>organelles</u>;</p> <p>b. nucleus/chloroplast/mitochondrion is double membraned/has inner and outer membrane;</p> <p>c. enzymes/substrates can be concentrated (in the small volume);</p> <p>d. different/incompatible functions/processes in different organelles (so harm prevented);</p> <p>e. hydrolytic/digestive enzymes held inside lysosomes/phagocytic vacuoles;</p> <p>f. pH/conditions can be optimized for (each) function/process;</p> <p>g. small spaces/volumes for proton gradient/concentration gradient (to develop quickly);</p> <p>h. (post- transcriptional) modification of mRNA in nucleus (before it reaches the ribosome);</p> <p>i. vesicles for transport/transfers;</p> <p>j. nuclear membrane/envelope protects DNA/chromosomes (from the cytoplasm);</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Do not award marks describing the functions of the plasma membrane. | 4 max |
| 9. | b | <p>a. diffusion/facilitated diffusion is passive movement/does not require ATP;</p> <p>b. diffusion/facilitated diffusion is movement from a higher to lower concentration;</p> <p>c. <u>simple diffusion</u> does not require channels/(membrane) proteins / is movement between phospholipid molecules;</p> <p>d. small/hydrophobic substances/oxygen/CO<sub>2</sub> pass across the membrane by simple diffusion;</p> <p>e. <u>facilitated diffusion</u> is movement through/assisted by channel proteins;</p> <p>f. (facilitated) diffusion/diffusion through channel proteins for polar molecules/ions/charged particles;</p> <p>g. <u>voltage-gating</u> allows channels to open and close / <u>voltage-gated</u> Na<sup>+</sup>/K<sup>+</sup> channels;</p> <p>h. <u>aquaporins</u> for osmosis/water movement/diffusion of water across the membrane;</p> <p>i. <u>active transport</u> is movement across the membrane using ATP/energy;</p> <p>j. active transport by protein pumps (in the membrane) / active transport by Na<sup>+</sup>/K<sup>+</sup> pump;</p> <p>k. active transport is (usually) movement (from lower) to higher concentration;</p> <p>l. endocytosis/phagocytosis takes materials in and exocytosis removes materials from the cell;</p> <p>m. formation of vesicles/vacuoles to take materials into the cell (by endocytosis);</p> <p>n. fusion of vesicles/vacuoles with plasma membrane to release materials (by exocytosis);</p> |                                                                     | 7 max |

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2225 – 6021

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Notes | Total |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 9. c     | <p>a. depolarization is due to movement/diffusion of sodium <u>ions</u> into the axon;</p> <p>b. by facilitated diffusion/through sodium channels (that have opened);</p> <p>c. repolarization is due to movement/diffusion of potassium (ions) out of axon;</p> <p>d. by facilitated diffusion/through potassium channels (that have opened);</p> <p>e. sodium/potassium channels are voltage-gated;</p> <p>f. <u>sodium-potassium pumps</u> generate concentration gradients/resting potential/higher sodium outside and higher potassium inside;</p> <p>g. <u>phospholipid bilayer</u> is impermeable to ions/allows concentration gradients of ions to be established;</p> |       | 4 max |

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Notes                                                                                   | Total |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------|
| 10 a     | <p>a. used as a source/(temporary) store of energy / is the energy currency of the cell;</p> <p>b. releases energy when converted to ADP/when a phosphate is removed;</p> <p>c. amount of energy released can be used/sufficient for (many metabolic) tasks;</p> <p>d. active transport/another valid example;</p> <p>e. ATP to ADP conversion is reversible / ATP can be regenerated from ADP;</p> <p>f. can be produced in different ways/using energy from different sources/by aerobic or anaerobic respiration;</p> <p>g. stable within cell so does not release energy prematurely/before needed;</p> <p>h. small molecule/soluble so can move easily/quickly (through the cell);</p> <p>i. cannot diffuse through membranes so is not lost from cell/to the environment;</p> | <p>h. The idea of ATP being small/soluble must be there along with its moveability.</p> | 3 max |

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2225 – 6021

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q4 | 1 marks

4.       C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q14 | 1 marks

14.      B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q4 | 1 marks

4.       A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q15 | 1 marks

15.      C  

Biology HL | Paper 1A | Specimen 2025 | Q15 | 1 marks

15.      A  

Biology HL | Paper 1A | Specimen 2025 | Q17 | 1 marks

17.       C

APOLLO

# Organelles and compartmentalization

4 questions

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q13 | 1 marks

13.       B  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q16 | 1 marks

16.       C  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q16 | 1 marks

16.       B

|    |   |     |                                                                                                                                                                                                                                                                                                                                                                                                                              |  |   |
|----|---|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 2. | a |     | to track their movement / make them detectable                                                                                                                                                                                                                                                                                                                                                                               |  | 1 |
| 2. | b | i   | rER                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 1 |
| 2. | b | ii  | a. production of polypeptides/proteins/translation;<br>b. (production of proteins that are) insoluble/bound for export/for insertion in the membrane;                                                                                                                                                                                                                                                                        |  | 2 |
| 2. | b | iii | high levels of radioactive amino acids appear first in X and later in Golgi                                                                                                                                                                                                                                                                                                                                                  |  | 1 |
| 2. | c |     | a. water diffuses (through the plasma membrane) via aquaporins<br><b>OR</b><br>aquaporins allow water movement/secretion of fluid;<br>b. the rate of water transport by aquaporins is not very high (so many are required);                                                                                                                                                                                                  |  | 1 |
| 2. | d |     | a. the sequence of amino acids determines the tertiary structure of a protein;<br>b. tertiary structure is the folding of a polypeptide chain;<br>c. R groups of amino acids can be polar or non-polar;<br>d. the protein folds due to interaction with water/the aqueous environment;<br>e. (the protein folds due to) R group interactions;<br>f. example of R group interaction H/covalent/ionic bond/disulphide bridges; |  | 4 |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Cell specialization

6 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q16 | 1 marks

16.      A

Biology HL | Paper 1A | May 2025 TZ2 | Q16 | 1 marks

16.      A

Biology HL | Paper 1A | May 2025 TZ3 | Q16 | 1 marks

16.      B

Biology HL | Paper 1A | Nov 2025 TZ3 | Q12 | 1 marks

12.      C

Biology HL | Paper 1A | Nov 2025 TZ3 | Q14 | 1 marks

14.      B

Biology HL | Paper 1A | Specimen 2025 | Q16 | 1 marks

16.      A

APOLLO

# Gas exchange

9 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q15 | 1 marks

15.     D

Biology HL | Paper 1A | May 2025 TZ1 | Q23 | 1 marks

23.     C

Biology HL | Paper 1A | May 2025 TZ2 | Q23 | 1 marks

23.     A

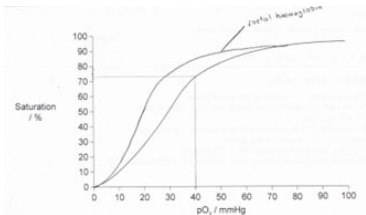
Biology HL | Paper 1A | May 2025 TZ3 | Q25 | 1 marks

25.     D

|    |   |                                                                                                                                                                                                                    |                                                                                                                                                                        |       |
|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1. | a | 73%;                                                                                                                                                                                                               | Accept answers between 71 and 74 %.<br>Units required.                                                                                                                 | 1     |
| 1. | b | a. as $pO_2$ increases, % saturation increases<br><b>OR</b><br>positive correlation/relationship;<br>b. % saturation levels off/plateaus/OWTTE (at higher partial pressure);<br>c. sigmoidal relationship/S curve; | a., b. Accept quoting values for increase and levelling off.<br><br>c. Do not accept other terms than sigmoid or S shaped curve.<br><br>Do not accept 100% saturation. | 2 max |

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2225 – 6014

| Question | Answers                                                                                                                                                                                                                                                                                               | Notes                                                                                                                                                                                                                                                          | Total |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1. c     | curve should be the sigmoidal and drawn to the left of the oxygen dissociation curve;<br>                                                                                                                          | Labels not necessary.<br>Not necessary that curves meet at high $pO_2$ .                                                                                                                                                                                       | 1     |
| 1. d     | a. oxygen binds to the haem group/iron;<br>b. haemoglobin structure / 4 haem groups allow for <u>cooperative binding</u> of oxygen;<br>c. when one oxygen binds to haemoglobin oxygen affinity increases due to change in conformation (of haemoglobin);                                              |                                                                                                                                                                                                                                                                | 1 max |
| 1. e     | a. tidal volume is the volume of <u>air</u> moved into and/or out of the lungs in one normal/regular/unforced breath;<br>b. use a spirometer/named appropriate apparatus;<br>c. breathe/expire (normally) into the mouthpiece/tube (of the spirometer);<br>d. measure the volume of air breathed out; | Accept annotated diagrams of how the equipment is used.<br><br>a. Do not accept forced/deep/maximum breath, etc.<br>b. Do not accept respirometer or respiration belt.<br>Accept other apparatus enabling to measure air volume, e.g., balloon, bell jar, etc. | 3 max |

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2225 – 6014

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                  |              |
|-----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--------------|
| 10. | a | <p>a. a codon is a triplet of bases of <u>mRNA</u>;</p> <p>b. (a codon) codes for/ is translated into one amino acid;</p> <p>c. one codon (AUG) initiates the translation<br/><b>OR</b><br/>AUG codes for Methionine/Met;</p> <p>d. 3 codons (UAA, UAG and UGA) are stop codons;</p> <p>e. one codon in <u>mRNA</u> matches/pairs with anticodon in <u>tRNA</u><br/><b>OR</b><br/>complementary base pairing between <u>tRNA</u> and <u>mRNA</u> (in translation);</p> <p>f. genetic code is degenerate<br/><b>OR</b><br/>more than one codon/multiple codons can code for one amino acid;</p> <p>g. order of codons determines order of amino acids/primary structure of polypeptide/protein;</p> | <i>b. Allow codons code for/are translated into amino acids.</i> | <b>4 max</b> |
| 10. | b | <p>a. photosystems embedded/located in chloroplast/thylakoid membranes;</p> <p>b. two types of photosystems, (Photosystem I and Photosystem II/PSI and PSII);</p> <p>c. structure allows light energy to be captured;</p> <p>d. (energy used) to emit excited electron;</p> <p>e. molecular <u>arrays</u> of chlorophyll (and accessory pigments)<br/><b>OR</b><br/>photosystem combines different types of pigments in one <u>array</u>;</p> <p>f. a greater proportion of wavelengths can be absorbed / greater proportion of sunlight can be used<br/><b>OR</b><br/>a single molecule of chlorophyll would not be able to perform photosynthesis;</p>                                           |                                                                  | <b>3 max</b> |

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Notes | Total        |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|
| 10. c    | <p>a. increased (cellular) respiration can increase CO<sub>2</sub> levels in blood<br/><b>OR</b><br/>anaerobic (cellular) respiration produces lactic acid;</p> <p>b. due to exercise/lack of oxygen;</p> <p>c. (aqueous) carbon dioxide reacts to form carbonic acid/H<sup>+</sup> ions (and HCO<sub>3</sub><sup>-</sup> ions)<br/><b>OR</b><br/>increased CO<sub>2</sub> levels in blood cause a decrease in pH/acidosis<br/><b>OR</b><br/>lactic acid in blood can release H<sup>+</sup> ions / can cause a decrease in pH/acidosis;</p> <p>d. in the presence of carbonic anhydrase (enzyme);</p> <p>e. <u>chemoreceptors</u> detect levels of carbon dioxide (in the blood)<br/><b>OR</b><br/><u>chemoreceptors</u> monitor (blood) pH / H<sup>+</sup> (in blood);</p> <p>f. (chemoreceptors) found in aorta/carotid arteries;</p> <p>g. (chemosensors/chemoreceptors) send information to respiratory centre in brain<br/><b>OR</b><br/>to the medulla/brainstem;</p> <p>h. (medulla) sends nervous impulses to the <u>external</u> intercostal muscles;</p> <p>i. (medulla) sends nervous impulses to the diaphragm;</p> <p>j. through intercostal/phrenic nerve;</p> <p>k. increasing breathing/ventilation rate;</p> <p>l. increasing volume of the lungs (during inhalation)/ increasing depth of breathing;</p> |       | <b>8 max</b> |

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |       |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|
| 4. | a | increases/higher (volume of air inhaled/exhaled per minute);                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  | 1     |
| 4. | b | by chemoreceptors<br><b>OR</b><br>in the brainstem / medulla (oblongata) / carotid artery / aorta;                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 1     |
| 4. | c | a. changes/increases/decreases in carbon dioxide concentration/level;<br>b. (increases in) carbon dioxide reduce pH/converse;<br>c. carbon dioxide produced by (aerobic cell) respiration;<br>d. removal of carbon dioxide from the blood in the lungs / by ventilation / by exhalation/expiration;<br>e. dissociation of carbonic acid / hydrogen ions from carbonic acid / $\text{H}_2\text{CO}_3$ to $\text{HCO}_3^- + \text{H}^+$ ;<br>f. lactic acid produced by anaerobic respiration / lactic acid reduces blood pH; |  | 2 max |
| 4. | d | diaphragm;<br><u>external</u> intercostal muscles;                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | 2     |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                      |          |
|----|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 5. | a | <p>a. diaphragm flattens<br/><b>OR</b><br/>volume inside the thorax/chest increases;</p> <p>b. pressure inside the thorax/chest/lungs decreases (below atmospheric pressure);</p> <p>c. air enters lungs to equalise the pressure<br/><b>OR</b><br/>air enters lungs moving from high to low pressure;</p> | <p><i>For c. do not accept just "air enters the lungs" without an explanation.</i></p>                                                                                                                                                               | 2<br>max |
| 5. | b | (external) intercostal (muscles);                                                                                                                                                                                                                                                                          | <p><i>Do not accept "internal" intercostal muscles. If the answer refers to both "internal and external" intercostal muscles (without any clarification on the role of each), then it is considered a contradiction, award no marking point.</i></p> | 1        |

– 13 –

8825 – 6021M

| Question |   |  | Answers                                                                                                                                                                                                                                                                                                                                                                                    | Notes                                                | Total                             |
|----------|---|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-----------------------------------|
| 5.       | c |  | <p>a. moistens the inside wall/surface of the <u>alveoli</u> (for gas exchange);</p> <p>b. reduces surface tension (inside alveoli);</p> <p>c. prevents (alveoli) walls/surfaces sticking together</p> <p><b>OR</b></p> <p>helps to prevent collapse of the lungs;</p> <p>d. enhances (alveolar) expansion of lungs</p> <p><b>OR</b></p> <p>allows the inflation of lungs after birth;</p> | <p><i>For c. (second strand) accept alveoli.</i></p> | <p><b>2</b></p> <p><b>max</b></p> |

– 14 –

8825 – 6021M

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                      |   |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---|
| 4. | a | <p>a. concentration in blood is lower than air / blood arriving at alveoli is oxygen poor/deoxygenated;<br/> b. oxygen moves into blood by diffusion;<br/> c. oxygen concentration in alveolar air lower than in atmospheric air;<br/> d. ventilation occurs<br/> <b>OR</b><br/> alveolar air replaced by (oxygen rich) atmospheric air;<br/> e. flow of blood in capillaries maintains concentration gradient;</p> | Allow converse for CO <sub>2</sub> for MP a, b and c | 3 |
| 4. | b | <p>a. rich capillary supply;<br/> b. epithelium is one cell thick;<br/> c. moist surface;<br/> d. large surface area / high surface area to volume ratio;</p>                                                                                                                                                                                                                                                       |                                                      | 2 |
| 4. | c | <p>a. plasma membrane has microvilli / is highly folded;<br/> b. large numbers of mitochondria (to supply energy for active transport);<br/> c. many vesicles formed by endocytosis;</p>                                                                                                                                                                                                                            |                                                      | 2 |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Transport

13 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q24 | 1 marks

24.          D  

Biology HL | Paper 1A | May 2025 TZ1 | Q25 | 1 marks

25.          C  

Biology HL | Paper 1A | May 2025 TZ2 | Q24 | 1 marks

24.          C  

Biology HL | Paper 1A | May 2025 TZ3 | Q24 | 1 marks

24.          A  

Biology HL | Paper 1A | May 2025 TZ3 | Q26 | 1 marks

26.          B  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q23 | 1 marks

23.          D  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q24 | 1 marks

24.          A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q25 | 1 marks

25.          B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q24 | 1 marks

24.          D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q25 | 1 marks

25.          C  

Biology HL | Paper 1A | Specimen 2025 | Q12 | 1 marks

12.          B  

Biology HL | Paper 1A | Specimen 2025 | Q26 | 1 marks

26.          D  

Biology HL | Paper 1A | Specimen 2025 | Q27 | 1 marks

27.          C

APOLLO

# Muscle and motility

7 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ2 | Q25 | 1 marks

25.          C  

Biology HL | Paper 1A | May 2025 TZ3 | Q15 | 1 marks

15.          D  

Biology HL | Paper 1A | May 2025 TZ3 | Q23 | 1 marks

23.          B  

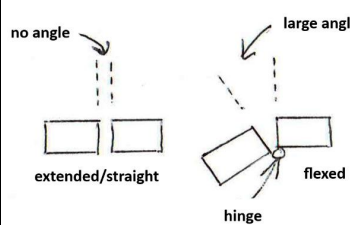
Biology HL | Paper 1A | Nov 2025 TZ3 | Q23 | 1 marks

23.          B

|    |   |    |                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                      |          |
|----|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 2. | a | i  | (joint) angle;                                                                                                                                                                                                                                                                                                 | <i>Do not accept degrees alone (which are the units, not the variable).</i>                                                                                                                                                                                                                                                                          | 1        |
| 2. | a | ii | outliers;                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                      | 1        |
| 2. | b |    | yes, as the results/medians/(IQR) ranges for both are very similar;                                                                                                                                                                                                                                            | <i>Do not accept means instead of medians.</i>                                                                                                                                                                                                                                                                                                       | 1        |
| 2. | c |    | <p><i>Strengths (max 1)</i></p> <p>a. large sample/range of results for both methods;</p> <p>b. many/three joints used;</p> <p>c. some variables were controlled;</p> <p>d. two methods of measurement;</p> <p><i>Limitation</i></p> <p>e. length of fingers/flexibility of joints not considered / OWTTE;</p> | <p><i>Award marking points for the design of the experiment but not for analyzing the results.</i></p> <p>a. Allow quoting the sample size (120).</p> <p>b. Results for all (MCP, PIP, DIP) are used.</p> <p>c. Accept named variables, e.g., left finger, healthy people.</p> <p>e. Accept other variables than left finger and healthy people.</p> | 2<br>max |

– 7 –

8825 – 6008M

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Notes                                                                                                                                                                                                                              | Total    |
|----------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 2.       | d | <p>a. when extended/straight no/very small angle</p> <p><b>OR</b></p> <p>if joint completely straight the angle would be 0(°)</p> <p><b>OR</b></p> <p>all angles are measured relative to the extended joint / OWTTE;</p> <p>b. angle increases when finger flexes/bends /vice versa</p> <p><b>OR</b></p> <p>flexion creates an angle (compared to extended);</p> <p>c. (finger joints) act as hinge (joints) when flexed / OWTTE;</p> <p>d. joint/measuring device (seen from above) opens when flexed, so larger angle/OWTTE;</p> <p>e. measuring device could be goniometer / (video and) computer/app analysis of images / protractor on image;</p> <p>f. different measuring devices produce similar results / OWTTE;</p> | <p>a. Allow 0°/180°.</p> <p>Allow answers using annotated diagrams.</p>  <p>Allow alternative terms, such as bent, flexed, straight, etc.</p> | 3<br>max |

– 8 –

8825 – 6008M

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |                                                                                                                                                     |                                                                                                                                                                                                                                                                                         |   |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 2. | a | towards the back of the hand/upwards/backwards;                                                                                                     | <p>Accept movement to the side if the hand is identified e.g. towards the left in the left hand.</p> <p>Accept clear description of the movement relative to the hand e.g. away from the palm.</p> <p>Do not accept only bending or flexing the finger. Direction must be included.</p> | 1 |
| 2. | b | (video and) computer/app analysis of images<br><b>OR</b><br>goniometer;                                                                             | <p>Accept use a protractor <u>on an image</u>.</p> <p>Do not accept protractor on its own.</p>                                                                                                                                                                                          | 1 |
| 2. | c | 63 to 65 (for method 1 – lowest value)<br><b>OR</b><br>79 to 81 (for method 1 – value on correlation line)<br><b>OR</b><br>88 to 90 (for method 2); | <p>Angle unit not required.</p> <p>Mark first answer only.</p> <p>Accept a value in the ranges given.</p>                                                                                                                                                                               | 1 |
| 2. | d | ligaments/tendons;                                                                                                                                  | .                                                                                                                                                                                                                                                                                       | 1 |

– 8 –

8825 – 6020M

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Notes                                                                                                                                                                                                                                                                                                               | Total |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2. e     | strong/good/high correlation<br><b>OR</b><br>the two methods have good agreement;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                     | 1     |
| 2. f     | <p><b>Structure</b></p> <p>a. <u>lignified/lignin</u> in walls provides support/prevents collapsing/resists (negative) pressure/tension;</p> <p>b. polar walls allow for the adhesion of water molecules (for capillary action);</p> <p><b>Transport</b></p> <p>c. no cell contents/empty/hollow so transport is not impeded;</p> <p>d. end walls absent/incomplete/perforated for unimpeded flow</p> <p><b>OR</b></p> <p>long continuous tubes allowing for continuous column of water;</p> <p>e. pits/gaps/pores in walls allow (lateral) movement/entry and exit of water/minerals;</p> <p>f. small diameter allows for capillary action/tension in water column;</p> | <p>Each structure must include an explanation.</p> <p>a. Do not accept cellulose instead of lignin.</p> <p>b. Accept hydrogen bonding as indicating polar bonding to the walls through adhesive forces.</p> <p>e. Do not accept reference to osmosis but accept reference to water movement into/out of phloem.</p> | 3 max |

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8825 – 6020M

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                              |       |
|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|-------|
| 3. | a | a. providing energy/ATP<br><b>OR</b><br>for <u>aerobic respiration</u> ;<br>b. for muscle contraction<br><b>OR</b><br>to break cross-bridges (between myosin heads and actin);                                                                                                                                                                                                                                                                                                                                     | <i>b. can be awarded even if the answer states 'contraction and relaxation/lengthening'.</i> | 2     |
| 3. | b | a. actin and myosin (filaments) slide over each other to shorten/contract the sarcomere/muscle<br><b>OR</b><br>sliding filament theory of muscle contraction;<br>b. myosin in centre and actin at ends of sarcomere;<br>c. myosin heads bind to actin/form cross-bridges/cross-linkages;<br>d. myosin heads tilt/swivel<br><b>OR</b><br>myosin heads move/detach using (energy from) ATP;<br>e. actin filaments moved towards the center of the sarcomere<br><b>OR</b><br>actin and myosin filaments overlap more; |                                                                                              | 3 max |

– 10 –

8825 – 6009M

| Question | Answers                                                                                                                                                                                                                                                                           | Notes | Total |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 3. c     | a. attaches myosin to the Z-line / keeps myosin centred in the sarcomere;<br>b. stores potential energy/elastic energy;<br>c. helps sarcomeres recoil / enhances next muscle contraction/relaxation/lengthening;<br>d. prevents overstretching/straining of the sarcomere/muscle; |       | 2 max |

– 11 –

8825 – 6009M

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Adaptation to environment

4 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ2 | Q35 | 1 marks

35.          D  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q1 | 1 marks

1.          A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q39 | 1 marks

39.          A

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                    |          |
|----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------|
| 6. | a | a. groups/types of ecosystems / ecosystems with similar communities;<br>b. with similar/characteristic abiotic/climatic conditions/rainfall/temperatures;<br>c. convergent evolution (produces similarities between ecosystems in a biome);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                    | 2<br>max |
| 6. | b | a. extensive roots (to collect water from a wide area/to collect water after rainfall);<br>b. deep roots to collect water from underground sources;<br>c. (thick) waxy cuticle to reduce transpiration/water loss/evaporation;<br>d. water storage tissue/thick stems/thick leaves/succulent (to survive droughts);<br>e. no leaves/narrow leaves/rolled leaves/spines instead of leaves to reduce the surface area for transpiration/evaporation;<br>f. fewer stomata/sunken/pitted stomata to reduce transpiration/water loss;<br>g. vertical stems to reduce exposure to sun at midday/heating when the sun is overhead/hottest<br><b>OR</b><br>pleated stems to allow shrinkage and reswelling/to store water;<br>h. stomata open at night/CAM metabolism; | Mark first three adaptations only. | 3<br>max |
| 6. | c | spines/thorns/stings/spikes<br><b>OR</b><br>production of toxins/unpalatable substances<br><b>OR</b><br>mimicry/camouflage (to resemble rocks)<br><b>OR</b><br>mutualism with an ant/animal which defends the acacia/plant against herbivores;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                    | 1<br>max |

APOLLO

# Ecological niches

3 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q35 | 1 marks

35.          B  

Biology HL | Paper 1A | May 2025 TZ2 | Q36 | 1 marks

36.          A  

Biology HL | Paper 1A | Specimen 2025 | Q36 | 1 marks

36.          C

APOLLO

# Enzymes and metabolism

11 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q5 | 1 marks

5.       B  

Biology HL | Paper 1A | May 2025 TZ2 | Q5 | 1 marks

5.       C  

Biology HL | Paper 1A | May 2025 TZ3 | Q5 | 1 marks

5.       D  

Biology HL | Paper 1A | May 2025 TZ3 | Q6 | 1 marks

6.       B

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                    |          |
|----|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 3. | a | i  | statin/inhibitor concentration<br><b>OR</b><br>type of statin;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                    | 1        |
| 3. | a | ii | pH / temperature / concentration of substrate/enzyme / volume of substrate/enzyme / size of containers / time;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                    | 1<br>max |
| 3. | b |    | <p><u>Similarities [max 2]</u></p> <p>a. (overall) with both statins, activity of HMG-CoA reductase/enzyme decreases as concentrations (of statins) increase;</p> <p>b. both statins cause the most reduction/decrease in activity / inhibition (of HMG-CoA reductase/enzyme) when concentrations increase from 0 to 80 <math>\mu\text{M}</math>;</p> <p>c. the activity of HMG-CoA reductase/ the enzyme is the same between 0-40 <math>\mu\text{M}</math>/at 260 <math>\mu\text{M}</math> of statins</p> <p><u>Differences [max 2]</u></p> <p>d. between 80 and 160 <math>\mu\text{M}</math>, activity (of HMG-CoA reductase/enzyme) decreases more with S1 than with S2;</p> <p>e. as concentrations of statins increase from 160 to 320 <math>\mu\text{M}</math>, the activity (of HMG-CoA reductase/enzyme) increases with S1 but continues decreasing with S2;</p> <p>f. the greatest inhibitory effect/ reduction in enzyme activity occurs at a concentration of 160 <math>\mu\text{M}</math> with S1, but at 320 <math>\mu\text{M}</math> with S2;</p> | <p>Both similarities and differences needed for 3 marks</p> <p>c. Allow values between 0-50 <math>\mu\text{M}</math> / 250-270 <math>\mu\text{M}</math>.</p> <p>d. Vice versa.</p> | 3<br>max |

– 8 –

2225 – 6008M

| Question                               |                                               | Answers                                                                                                                                                                                                                                                                                                                                                                   | Notes                                                                                | Total                          |                                |                                   |                           |                                               |                                        |                                           |                                                                                    |                                |
|----------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------|--------------------------------|-----------------------------------|---------------------------|-----------------------------------------------|----------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------|--------------------------------|
| 3.                                     | c                                             | <p>a. volume/concentration of product present divided by time taken for its appearance<br/><b>OR</b><br/>volume/concentration of substrate used divided by time taken for its disappearance;</p> <p>b. reciprocal of time taken (1/time taken) for either product to appear or substrate to disappear;</p>                                                                | <p><i>Must have an indication of time.</i></p> <p><i>Accept correct formula.</i></p> | <p><b>1</b><br/><b>max</b></p> |                                |                                   |                           |                                               |                                        |                                           |                                                                                    |                                |
| 3.                                     | d                                             | <table><tr><th>Competitive</th><th>Non-competitive</th></tr><tr><td>a. binds to <u>active</u> site</td><td>binds to <u>allosteric</u> site ;</td></tr><tr><td>b. blocks the active site</td><td>changes the shape of the enzyme/active site ;</td></tr><tr><td>c. affected by substrate concentration</td><td>not affected by substrate concentration ;</td></tr></table> | Competitive                                                                          | Non-competitive                | a. binds to <u>active</u> site | binds to <u>allosteric</u> site ; | b. blocks the active site | changes the shape of the enzyme/active site ; | c. affected by substrate concentration | not affected by substrate concentration ; | <p><i>Answer should include both distinguishing statements to gain 1 mark.</i></p> | <p><b>1</b><br/><b>max</b></p> |
| Competitive                            | Non-competitive                               |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                      |                                |                                |                                   |                           |                                               |                                        |                                           |                                                                                    |                                |
| a. binds to <u>active</u> site         | binds to <u>allosteric</u> site ;             |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                      |                                |                                |                                   |                           |                                               |                                        |                                           |                                                                                    |                                |
| b. blocks the active site              | changes the shape of the enzyme/active site ; |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                      |                                |                                |                                   |                           |                                               |                                        |                                           |                                                                                    |                                |
| c. affected by substrate concentration | not affected by substrate concentration ;     |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                      |                                |                                |                                   |                           |                                               |                                        |                                           |                                                                                    |                                |

| Question |   |  | Answers                        | Notes                                                                               | Total                                          |          |
|----------|---|--|--------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------|----------|
| 3.       | e |  |                                |                                                                                     | Process and description must match for 2 marks | 2<br>max |
|          |   |  | a. name of process             | b. description                                                                      |                                                |          |
|          |   |  | (blood) clotting;              | thrombin converts fibrinogen to fibrin (blocks/prevents entrance of pathogens);     |                                                |          |
|          |   |  | phagocytosis;                  | (hydrolytic) enzymes (present in lysosomes) digest/ break down pathogens/ bacteria; |                                                |          |
|          |   |  | secretion of mucus;            | enzymes in mucus kill/destroy pathogens;                                            |                                                |          |
|          |   |  | B-lymphocytes/ plasma B-cells; | use enzymes to produce antibodies (once activated);                                 |                                                |          |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q5 | 1 marks

5.       A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q6 | 1 marks

6.       D

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 9. | a | <p>a. signalling chemicals/ligands bind to receptors;</p> <p>b. reference to specificity / the shape (and chemical properties) of the ligand-binding site match those of the ligand;</p> <p>c. receptors can be in (either) the plasma membrane / intracellular / in the cytoplasm / or nucleus</p> <p><b>OR</b></p> <p>ligand can bind to transmembrane receptors/receptors in the plasma membrane or intracellular receptors;</p> <p>d. only cells with a receptor to a signalling chemical will respond;</p> <p>e. reference to signal transduction (initiated by signalling chemical-receptor binding);</p> <p>f. example of signalling chemical;</p> | <p><i>Do not accept the role of glycoproteins in cell-cell recognition or ABO glycoproteins.</i></p> <p><i>For b: do not accept "complementary" as this is part of the stem question.</i></p> <p><i>For e. OWTTE</i></p> <p><i>For e. the reference may include the pathway followed by a given example of a signalling chemical.</i></p> <p><i>Appropriate example for (f):</i></p> <ul style="list-style-type: none"> <li>• Neurotransmitters/named neurotransmitter</li> <li>• any named hormone</li> <li>• Cytokine</li> <li>• Calcium ions</li> </ul> | <b>4 max</b> |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Notes                                                                                                                                                                                                                      | Total        |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 9. b     | <p>a. enzymes are globular proteins with an active site (for catalysis);</p> <p>b. substrates must bind to the active site to be catalysed;</p> <p>c. description of induced fit mechanism / substrate can cause active site to change shape;</p> <p>d. conformational changes/changes in tertiary structure do not allow substrate to bind to active site / enzyme is denatured;</p> <p>e. denaturation decreases enzyme activity / enzymes no longer work;</p> <p>f. high temperatures/temperatures above the optimum break bonds in the enzymes / cause conformational changes to active site / denature enzymes;</p> <p>g. below the optimum temperature enzymes may be inhibited</p> <p><b>OR</b></p> <p>increased temperature increases kinetic energy, increasing enzyme activity (because of more collisions) up to optimum temperature;</p> <p>h. (changes in) pH cause changes in charges /alteration of (ionic/ H) bonds (between amino acids) / affect shape of active site / the enzyme becomes denatured (at higher or lower pH values than the optimum)</p> <p>i. <u>non-competitive inhibitors</u> bind to an allosteric site;</p> <p>j. (non-competitive inhibitors) cause disruption of hydrogen/ionic/disulfide/hydrophobic interactions;</p> <p><b>Marking point for 9b continued on next page...</b></p> | <p><i>Ignore references to substrate concentration</i></p> <p><i>Ignore references to competitive inhibitors</i></p> <p><i>For h. do not accept that the enzyme is inhibited because of pH different from optimum.</i></p> | <b>7 max</b> |

## 9b continued...

|    |   |                                                                                                                                                                                                                                                                                                       |  |  |
|----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| 9. | b | <p>k. (non-competitive inhibitors) cause conformational change of the enzyme / changes in the active site of the enzyme;</p> <p>l. (non-competitive inhibitors) decrease rate of enzyme-substrate complex formation / substrate can no longer bind to the active site / decrease enzyme activity;</p> |  |  |
|----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Notes                                                                                                                                                                                                                                                                             | Total        |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 9. c     | <p>a. haemoglobin transports oxygen by binding to it in the lungs and releasing it in tissues that require oxygen<br/><b>OR</b><br/>association/loading of oxygen to haemoglobin happens in the lungs<br/><b>OR</b><br/>dissociation/unloading of oxygen from haemoglobin occurs at cells that require oxygen/respoding tissues;</p> <p>b. each haemoglobin molecule can carry four oxygen molecules<br/><b>OR</b><br/>reference to cooperative binding / the binding of one oxygen molecule to a haemoglobin (subunit) increases the affinity of the other subunits for oxygen/makes it easier for the other oxygen molecules to bind;</p> <p>c. at low partial pressures of oxygen/when oxygen concentration is low, hemoglobin has a low affinity for oxygen<br/><b>OR</b><br/>at high partial pressures of oxygen/when oxygen concentration is high, oxygen has a high affinity for haemoglobin / (readily) binds to haemoglobin;</p> <p>d. (at low partial pressures of oxygen/ when oxygen concentration is low) this enables oxygen to dissociate/diffuse more readily at/into respoding tissues;</p> <p>e. provides more oxygen for aerobic respiration in the tissues;</p> <p><b>Marking point for 9c continued on next page...</b></p> | <p><i>For a. accept OWTTE.</i></p> <p><i>For c. and g. Can be answered using a dissociation curve graph with labelled axes and annotations referring to the marking points c. and g.</i></p> <p><i>Ignore references to foetal haemoglobin (question requires adult only)</i></p> | <b>4 max</b> |

9c continued...

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |  |
|----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| 9. | c | <p>f. carbon dioxide from respiring tissues binds to haemoglobin;</p> <p>g. low pH / high concentration of carbon dioxide/carbonic acid causes Bohr shift / shift of curve to the right</p> <p><b>OR</b></p> <p>low pH / high concentration of carbon dioxide/carbonic acid promotes the release of oxygen from haemoglobin (to tissues);</p> <p>h. Bohr shift reduces the affinity of haemoglobin for oxygen</p> <p><b>OR</b></p> <p>Bohr shift results in oxygen unloading/diffusing easier to respiring tissues;</p> |  |  |
|----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q7 | 1 marks

7.       D  

Biology HL | Paper 1A | Specimen 2025 | Q8 | 1 marks

8.       A

| 9.                                                                       | a                                                                       |  | <p>a. some toxins/DDT are persistent/degrade slowly (once released into the environment);</p> <p>b. (some toxins/DDT) enter the food chain through producers/lower trophic levels;</p> <p>c. (some toxins/DDT) are passed on to higher trophic levels in the food chain;</p> <p>d. (they are) difficult to excrete / are not excreted;</p> <p>e. (they) accumulate in fatty tissues of animals;</p> <p>f. higher trophic levels/top consumers have higher/the highest concentration of pesticides in their bodies;</p> <p>g. they bioaccumulate/biomagnify;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        | 4                          |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------------|---------------|--|----------------------------|--|--------------------------------------------------------------------------|--|--------------|--|--------------------------------|------------------------------|---------------------------------------------|-------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------|--------------------------|------------------------------------|------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|----------------------------------------------|------------------------------------------------------|-------|
| 9.                                                                       | b                                                                       |  | <table><tr><th>Competitive inhibition</th><th>Non-competitive inhibition</th></tr><tr><td colspan="2">Similarities:</td></tr><tr><td colspan="2">slow down enzyme activity;</td></tr><tr><td colspan="2">interact with R chains of amino acids at the surface of enzyme molecule;</td></tr><tr><td colspan="2">Differences:</td></tr><tr><td>inhibitor binds to active site</td><td>does not bind to active site</td></tr><tr><td>inhibitor does not bind to allosteric site;</td><td>inhibitor binds to allosteric site;</td></tr><tr><td>substrate cannot bind due to blockage of active site</td><td>substrate cannot bind due to disruption/change in shape of active site;</td></tr><tr><td>inhibition is reversible</td><td>inhibition is (usually) permanent;</td></tr><tr><td>inhibitor has similar shape to substrate</td><td>inhibitor does not have similar shape to substrate;</td></tr><tr><td>can be reversed by increasing substrate concentration</td><td>adding substrate does not reduce inhibition;</td></tr></table> <p>a valid example of each;</p> | Competitive inhibition | Non-competitive inhibition | Similarities: |  | slow down enzyme activity; |  | interact with R chains of amino acids at the surface of enzyme molecule; |  | Differences: |  | inhibitor binds to active site | does not bind to active site | inhibitor does not bind to allosteric site; | inhibitor binds to allosteric site; | substrate cannot bind due to blockage of active site | substrate cannot bind due to disruption/change in shape of active site; | inhibition is reversible | inhibition is (usually) permanent; | inhibitor has similar shape to substrate | inhibitor does not have similar shape to substrate; | can be reversed by increasing substrate concentration | adding substrate does not reduce inhibition; | Answers must have at least one similarity for 7 max. | 7 max |
| Competitive inhibition                                                   | Non-competitive inhibition                                              |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| Similarities:                                                            |                                                                         |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| slow down enzyme activity;                                               |                                                                         |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| interact with R chains of amino acids at the surface of enzyme molecule; |                                                                         |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| Differences:                                                             |                                                                         |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| inhibitor binds to active site                                           | does not bind to active site                                            |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| inhibitor does not bind to allosteric site;                              | inhibitor binds to allosteric site;                                     |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| substrate cannot bind due to blockage of active site                     | substrate cannot bind due to disruption/change in shape of active site; |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| inhibition is reversible                                                 | inhibition is (usually) permanent;                                      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| inhibitor has similar shape to substrate                                 | inhibitor does not have similar shape to substrate;                     |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |
| can be reversed by increasing substrate concentration                    | adding substrate does not reduce inhibition;                            |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                            |               |  |                            |  |                                                                          |  |              |  |                                |                              |                                             |                                     |                                                      |                                                                         |                          |                                    |                                          |                                                     |                                                       |                                              |                                                      |       |

(continued...)

(Question 9 continued)

| Question | Answers | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Total |
|----------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 9.       | c       | <p>a. lower rate of <u>aerobic</u> respiration / inhibits <u>aerobic</u> respiration;</p> <p>b. reduced NAD (not oxidised) accumulates;</p> <p>c. fewer/no electrons (from reduced NAD and FADH) to be transported by carriers;</p> <p>d. less/no energy to transfer protons (from matrix to intermembrane space);</p> <p>e. proton gradient cannot be maintained;</p> <p>f. less/no diffusion of protons through ATP synthase;</p> <p>g. ADP is not phosphorylated / less ATP produced / no energy to produce ATP;</p> <p>h. oxygen not binding to protons / accepting electrons / no water formed;</p> | 4     |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Cell respiration

8 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q6 | 1 marks

6.       B  

Biology HL | Paper 1A | May 2025 TZ1 | Q7 | 1 marks

7.       C

|    |   |    |                                                                                                                                                                                                                                                                                    |  |          |
|----|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------|
| 6. | a | i  | between glucose and fructose 1,6 – bisphosphate;                                                                                                                                                                                                                                   |  | 1        |
| 6. | a | ii | between triose phosphate and pyruvate;                                                                                                                                                                                                                                             |  | 1        |
| 6. | b |    | cytoplasm;                                                                                                                                                                                                                                                                         |  | 1        |
| 6. | c |    | a. NADH transfers electrons to pyruvate<br><b>OR</b><br>pyruvate acts as electron acceptor / pyruvate is reduced;<br>b. (pyruvate) converted to lactate;<br>c. NADH oxidized/converted to NAD<br><b>OR</b><br>NAD available to be reduced/converted to NADH again (in glycolysis); |  | 2<br>max |

| Question |   |  | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Notes | Total    |
|----------|---|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 7        | a |  | <u>allopatric</u> ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       | 1        |
| 7        | b |  | a. geographic isolation/geographic barrier/separation of populations (of the common ancestor) by the river;<br>b. (isolated populations) subjected to different/ <u>selection</u> /environmental pressures;<br>c. their allele frequencies changed/ genetic drift/genetic differences/different mutations/adaptations accumulated over time/passed on to offspring;<br>d. until they could not interbreed anymore/reproductive isolation / populations became separate species;<br>e. divergence due to differential selection; |       | 3<br>max |

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q6 | 1 marks

6.       B  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q7 | 1 marks

7.       C  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q5 | 1 marks

5.       A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q8 | 1 marks

8.       D  

Biology HL | Paper 1A | Specimen 2025 | Q34 | 1 marks

34.       B

APOLLO

# Photosynthesis

10 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q8 | 1 marks

8.       D  

Biology HL | Paper 1A | May 2025 TZ1 | Q14 | 1 marks

14.      B  

Biology HL | Paper 1A | May 2025 TZ2 | Q6 | 1 marks

6.       C  

Biology HL | Paper 1A | May 2025 TZ2 | Q7 | 1 marks

7.       D  

Biology HL | Paper 1A | May 2025 TZ2 | Q8 | 1 marks

8.       B  

Biology HL | Paper 1A | May 2025 TZ3 | Q7 | 1 marks

7.       B  

Biology HL | Paper 1A | May 2025 TZ3 | Q36 | 1 marks

36.       D

|     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |          |
|-----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------|
| 10. | b | <p>a. ATP produced by photosynthesis/in chloroplasts<br/><b>OR</b><br/>photosynthesis occurs in the chloroplast / photosynthesis produces glucose;</p> <p>b. ATP synthase/electron carriers/proton pumps/photosystems/pigments in the thylakoid membrane<br/><b>OR</b><br/>ATP synthase/electron carriers/proton pumps the inner mitochondrial membrane/cristae;</p> <p>c. chlorophyll/pigments absorb light;</p> <p>d. in photosystems/Photosystem I/Photosystem II/antenna complexes;</p> <p>e. electrons (in chlorophyll/pigments) raised to higher energy levels/become excited;</p> <p>f. (excited) electrons passed between carriers/along the electron transport chain;</p> <p>g. energy from electrons used (by carriers) to pump protons/H<sup>+</sup> ions;</p> <p>h. from the stroma to the thylakoid space;</p> <p>i. proton gradient generated/high concentration of protons generated in the thylakoid space/lumen;</p> <p>j. protons flow back (to stroma) through ATP synthase;</p> <p>k. ADP phosphorylated / ADP and phosphate converted to ATP / ATP made by phosphorylating ADP;</p> <p>l. cyclic (photophosphorylation) only uses PS1 but non-cyclic uses both/PS1 and PS2;</p> <p>m. water is split (by photolysis) to replace electrons lost (by photosystem);</p> |  | 7<br>max |
|-----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------|

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| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Notes | Total    |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 10. c    | <p><i>Similarities</i></p> <p>a. (all heterotrophs) use foods/carbon compounds/other organisms as their energy source/to use for ATP production;</p> <p>b. (all heterotrophs) get energy/carbon compounds/organic compounds/glucose/carbohydrate/lipids/fats from other organisms;</p> <p><i>Differences</i></p> <p>c. saprotrophs/decomposers feed on dead organic matter;</p> <p>d. saprotrophs/decomposers secrete digestive enzymes into the food source / digest externally;</p> <p>e. consumers feed on living organisms/other organisms;</p> <p>f. primary consumers feed on plants/other example of feeding relationships in a food chain;</p> <p>g. detritivores ingest detritus/<i>OWTTE</i>;</p> <p>h. digestion of food so compounds can be absorbed;</p> <p>i. internal digestion in holozoic animals/detritivores;</p> <p>j. energy from carbon compounds used to produce ATP by cell respiration;</p> |       | 5<br>max |

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q8 | 1 marks

8.       D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q7 | 1 marks

7.       B

APOLLO

# Chemical signalling

14 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q28 | 1 marks

28.          D  

Biology HL | Paper 1A | May 2025 TZ1 | Q32 | 1 marks

32.          D  

Biology HL | Paper 1A | May 2025 TZ2 | Q18 | 1 marks

18.          B  

Biology HL | Paper 1A | May 2025 TZ2 | Q26 | 1 marks

26.          D  

Biology HL | Paper 1A | May 2025 TZ2 | Q28 | 1 marks

28.          B  

Biology HL | Paper 1A | May 2025 TZ3 | Q29 | 1 marks

29.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q17 | 1 marks

17.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q27 | 1 marks

27.          D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q17 | 1 marks

17.          B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q27 | 1 marks

27.          C  

Biology HL | Paper 1A | Specimen 2025 | Q18 | 1 marks

18.          D  

Biology HL | Paper 1A | Specimen 2025 | Q21 | 1 marks

21.          C  

Biology HL | Paper 1A | Specimen 2025 | Q22 | 1 marks

22.          B

|    |   |    |                                                                                                                      |  |   |
|----|---|----|----------------------------------------------------------------------------------------------------------------------|--|---|
| 3. | a | i  | arrow pointing from inside the cell to the right outside (accept arrow with its entirety in the cell/below the cell) |  | 1 |
| 3. | a | ii | gravity/light                                                                                                        |  | 1 |
| 3. | b | i  | the cells would be larger/longer with auxin                                                                          |  | 1 |
| 3. | b | ii | cytokinin                                                                                                            |  | 1 |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Neural signalling

16 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q17 | 1 marks

17.          B  

Biology HL | Paper 1A | May 2025 TZ1 | Q18 | 1 marks

18.          A  

Biology HL | Paper 1A | May 2025 TZ1 | Q26 | 1 marks

26.          B  

Biology HL | Paper 1A | May 2025 TZ2 | Q17 | 1 marks

17.          C  

Biology HL | Paper 1A | May 2025 TZ3 | Q17 | 1 marks

17.          D  

Biology HL | Paper 1A | May 2025 TZ3 | Q18 | 1 marks

18.          D

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |              |
|----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| 3. | a | <p>a. (voltage-gated) potassium channels are closed when there is a negative membrane potential / when there are (relatively) more negative charges inside / (relatively) more positive charges outside;</p> <p>b. (voltage-gated) potassium channels open after depolarization of the axon / after closing of sodium channels / when a positive membrane potential develops / at +30mV / at +40mV;</p> <p>c. <math>K^+</math> ions diffuse out of the cell / efflux of <math>K^+</math>;</p> <p>d. (efflux of <math>K^+</math>) causes/results in/happens during repolarization / membrane potential returns to -70mV/ to the resting potential;</p> <p>e. (voltage-gated) potassium channels close again (to terminate the action potential)</p> <p><b>OR</b></p> <p>globular protein ball (attached by a flexible chain of amino acids) blocks/closes the channel;</p> <p>f. (following an action potential) hyperpolarization can occur (due to slow closing of potassium channels / continued efflux of <math>K^+</math> before potassium channels close / nature of potassium channels);</p> |                                             | <b>3 max</b> |
| 3. | b | neurotransmitter (gated ion channel) / ligand (gated ion channel) / mechanically (gated ion channel);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <i>Do not accept examples.</i>              | <b>1</b>     |
| 3. | c | <p>a. <u>hydrophobic</u> regions at the phospholipid tail <b>and</b> <u>hydrophilic</u> regions at the heads;</p> <p>b. (long) carbon chains are <u>hydrophobic</u> (water insoluble) <b>and</b> phosphate head is <u>hydrophilic</u> (water soluble);</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <i>Both parts of the answer are needed.</i> | <b>1 max</b> |
| 3. | d | <p>a. modulates/adjusts/controls/regulates membrane fluidity;</p> <p>b. cholesterol stabilizes membranes/prevents membranes becoming too fluid/too porous at <u>higher temperatures</u>;</p> <p>c. cholesterol prevents membranes becoming viscous/inflexible/stiff/stiffening / cholesterol prevents solidification of saturated fatty acids at <u>lower temperature</u>;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             | <b>1 max</b> |
| 3. | e | <p>a. more unsaturated fatty acids more flexible/fluid;</p> <p>b. more saturated fatty acids less flexible/fluid;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <i>Accept vice versa</i>                    | <b>1 max</b> |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q15 | 1 marks

15.       B  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q18 | 1 marks

18.       A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q26 | 1 marks

26.       A  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q18 | 1 marks

18.       C  

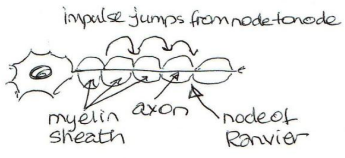
Biology HL | Paper 1A | Nov 2025 TZ3 | Q28 | 1 marks

28.       C

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                       |       |
|----|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3. | a |    | oscilloscope;                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                       | 1     |
| 3. | b | i  | a. SD is variability within a sample while the SE is the variability across samples of a population / OWTTE<br><b>OR</b><br>SD is for each sample/earthworm while SE for all the samples/earthworms;<br>b. SD could be calculated from 5 repeats while for SE 30 replicates is (considered) acceptable;<br>c. small SD shows data are clustered around the mean while small SE shows the sample mean is closer to the population mean / vice versa; | <i>Answers must make clear differences between the two.</i><br><i>Do not accept references to experimental / human errors for SE.</i> | 2 max |
| 3. | b | ii | only one replicate/measurement / OWTTE;                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                       | 1     |
| 3. | c | i  | 2.56 (faster)<br><b>OR</b><br>256 % (faster);                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Significant figures conventions not expected, so 2.5, 2.5555 etc. is acceptable.</i>                                               | 1     |

– 9 –

8825 – 6008M

| Question | Answers |    |                                                                                                                                                                                                                                                                                                                                                  | Notes                                                                                                                                                                                                                                                                                      | Total |
|----------|---------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3.       | c       | ii | a. MGF has larger <u>diameter</u> (of axon than LGF) / vice versa<br><b>OR</b><br>MGF is wider (than LGF) / vice versa;<br>b. MGF has (thicker) myelin sheath / vice versa;                                                                                                                                                                      | <i>Mark only the first answer written</i><br><i>Accept answers where MGF is implicit.</i><br><i>a. Do not accept "longer".</i><br><i>b. Accept "thicker myelin/more myelinated".</i>                                                                                                       | 1 max |
| 3.       | d       |    | a. electric insulation of axon by myelin sheath;<br>b. myelin sheath has nodes (of Ranvier);<br>c. impulses jump/transmitted from node to node;<br>d. ion pumps/channels are clustered at nodes (of Ranvier);<br>e. faster (than in unmyelinated axon) / OWTTE;<br>f. production of all-or-none action potentials by a single node (of Ranvier); | <i>b. Should be for explaining what the nodes are, marking point c. for "jumping", so awarding c. doesn't give marking point b. automatically.</i><br><i>Accept correctly annotated diagrams.</i><br> | 3 max |

– 10 –

8825 – 6008M

| Question | Answers |  |  | Notes | Total |
|----------|---------|--|--|-------|-------|
|----------|---------|--|--|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |
|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 8. | a | <p>a. binds to the active site / inhibitor is complementary to the active site;</p> <p>b. prevent binding of substrate (so reducing enzyme activity/rate of reaction)</p> <p><b>OR</b></p> <p>fewer enzyme-substrate complexes form;</p> <p>c. inhibitor chemically similar/similar in shape/similar in structure to substrate</p> <p>d. statins are competitive inhibitors of HMG-CoA reductase/enzyme needed to make cholesterol;</p> <p>e. statins prevent conversion of HMG-CoA to mevalonate;</p> | <p><i>Accept other examples for mark point d and mark point e such as:</i></p> <p><i>Oxygen binds to rubisco (d.) and preventing production of glycerate 3-phosphate (e.)</i></p> <p><i>Malonate binds to succinic dehydrogenase (d.), preventing production of fumarate (e.).</i></p> <p><i>Allow penicillin as a competitive inhibitor of transpeptidase/for bacterial cell wall production for mark point d, but not mark point e.</i></p> | 4<br>max |
|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Notes                                                                                                                                                                                                                                                                                                                        | Total    |
|----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 8.       | b | <p>a. depolarization/action potential in pre-synaptic membrane/pre-synaptic neuron causes release of neurotransmitter;</p> <p>b. by exocytosis/by fusion of vesicle with pre-synaptic membrane;</p> <p>c. neurotransmitter diffuses/travels across the synaptic cleft;</p> <p>d. neurotransmitter binds to receptors in postsynaptic membrane;</p> <p>e. (binding causes) ion/sodium/ligand-gated channels to open;</p> <p>f. post-synaptic membrane reaches threshold potential/depolarizes/action potential generated;</p> <p>g. neurotransmitter broken down / reabsorbed by presynaptic neuron</p> <p><b>OR</b></p> <p>exogenous chemicals/example of exogenous chemical not released from receptor/not broken down;</p> <p>h. exogenous chemicals can block/increase synaptic transmission;</p> <p>i. neonicotinoids bind to acetylcholine/neurotransmitter/post-synaptic <u>receptors</u>;</p> <p>j. excessive of Na<sup>+</sup> enters post-synaptic neuron / Na<sup>+</sup> channels remain open;</p> <p>k. cocaine binds to (dopamine) reuptake transporters;</p> <p>l. <u>dopamine</u> in the synaptic cleft continues to stimulate (post-synaptic neuron);</p> | <p><i>Allow 'acetylcholine' instead of neurotransmitter in mark points a, c and d.</i></p> <p><i>Accept 'cause constant depolarization' instead of 'increase synaptic transmission' in mark point h.</i></p> <p><i>Mark point h. can be awarded for a specific example of blocking/increasing synaptic transmission.</i></p> | 7<br>max |

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Notes                                                                                                                                                                                                                                                                                                                                                                               | Total        |
|----------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 8.       | c | a. HIV can be passed on/spread (by someone who is HIV positive);<br>b. HIV invades/infests/destroys <u>helper</u> T-lymphocytes / <u>CD4 cells</u> ;<br>c. all (helper/CD4) T-lymphocytes gradually/eventually destroyed;<br>d. B-lymphocytes not (sufficiently) activated without T-lymphocytes;<br>e. antibodies not produced (in sufficient quantity);<br>f. immunity to new infections/pathogens cannot develop / antibodies not produced in response to new pathogens/antigens<br>g. opportunistic infections cannot be controlled/eliminated / valid example of an opportunistic infection;<br>h. AIDS/acquired immune deficiency syndrome (develops);<br>i. rapid mutation rate in HIV so evades immune system/resists (anti-retroviral) drugs; | <i>Allow T-cells instead of T-lymphocytes and B-cells instead of B-lymphocytes.</i><br><br><i>Mark point a is awarded for spread of HIV from an infected person, not for spread to an uninfected person, because the question asks about the consequences of infection.</i><br><br><i>Do not award mark point f or mark point g for understatements such as 'reduced immunity'.</i> | <b>4 max</b> |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                  |   |
|----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|---|
| 3. | a | <p>a. saltatory conduction / nerve/electric impulse/action potential "jumps" from node (of Ranvier) to node (of Ranvier);</p> <p>b. myelin is an insulating material / does not allow ion exchange</p> <p><b>OR</b></p> <p>ion exchange / action potential only occurs at the nodes of Ranvier</p> <p><b>OR</b></p> <p>ion pumps/channels/Na<sup>+</sup> and K<sup>+</sup> channels clustered/more abundant/higher in numbers at nodes of Ranvier;</p>      |                                                                                  | 2 |
| 3. | b | <p>a. both involve transport of particles down/along a concentration gradient</p> <p><b>OR</b></p> <p>both are passive / do not require energy/ATP;</p> <p>b. facilitated diffusion requires membrane proteins/channel proteins whereas simple diffusion does not</p> <p><b>OR</b></p> <p>facilitated diffusion moves hydrophilic/polar particles/ions/large molecules, whereas simple diffusion moves hydrophobic/non-polar particles/small molecules;</p> | <p>OWTTE</p> <p><i>For b. allow correct reference to gated ion channels.</i></p> | 2 |

– 10 –

8825 – 6021M

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Notes                                         | Total                             |
|----------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------|
| 3.       | c | <p>a. prevent synaptic transmission;</p> <p>b. neonicotinoids act like / have similar structure to acetylcholine;</p> <p>c. neonicotinoids bind to <u>acetylcholine</u> receptors (in the post-synaptic membrane / in cholinergic synapses / between motor neuron and muscles);</p> <p>d. neonicotinoids are not broken down by acetylcholinesterase/enzymes;</p> <p>e. binding is irreversible</p> <p><b>OR</b></p> <p>receptors are blocked;</p> <p>f. the receptors are overstimulated</p> <p><b>OR</b></p> <p>acetylcholine cannot bind;</p> <p>g. paralyses/kills the insect;</p> | <p><i>For c. accept ACh abbreviation.</i></p> | <p><b>3</b></p> <p><b>max</b></p> |

– 11 –

8825 – 6021M

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q28 | 1 marks

28.          D

APOLLO

# Defence against disease

7 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q27 | 1 marks

27.      A

Biology HL | Paper 1A | May 2025 TZ3 | Q27 | 1 marks

27.      C

|    |   |  |  |  |                                                                                                                                                                   |       |
|----|---|--|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 5. | a |  |  |  | Award <b>[1]</b> per row.<br>A table format is not required.<br>Note: The command term is "distinguish" so a clear difference between the 2 concepts is required. | 1 max |
|    |   |  |  |  |                                                                                                                                                                   |       |
|    |   |  |  |  |                                                                                                                                                                   |       |
|    |   |  |  |  |                                                                                                                                                                   |       |
| 5. | b |  |  |  | Accept the terms T-cells and B-cells.                                                                                                                             | 2 max |
|    |   |  |  |  |                                                                                                                                                                   |       |
|    |   |  |  |  |                                                                                                                                                                   |       |
|    |   |  |  |  |                                                                                                                                                                   |       |

– 11 –

2225 – 6015

| Question |   | Answers                                                                                                                                                                                                                                                                                                    | Notes                                                | Total |
|----------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------|
| 5.       | c | a. DNA/RNA vaccines can be used because viruses have genetic material/RNA/DNA;<br>b. viruses have a capsid made of protein / protein capsule so antigen/parts of protein can be used as vaccine;<br>c. inactivated /attenuated virus can be used as immune system reacts against capsid / protein capsule; | Type of vaccines must be related to viral structure. | 2 max |

– 12 –

2225 – 6015

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q28 | 1 marks

28.          B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q26 | 1 marks

26.          B  

Biology HL | Paper 1A | Specimen 2025 | Q29 | 1 marks

29.          B

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |   |
|----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 8. | a | a. vaccinations are specific to a specific disease;<br>b. vaccines contain non-self antigens/antigens from pathogens;<br>c. can be live relative/attenuated version of the virus;<br>d. trigger a primary immune response (without causing the disease);<br>e. lymphocytes with specific receptors (are activated and) produce memory cells;<br>f. (memory cells) cause a faster production of antibodies on a second exposure/exposure to the disease;<br>g. (memory cells) provide long term immunity; |  | 7 |
| 8. | b | a. (during depolarization) $\text{Na}^+$ channels open;<br>b. allowing $\text{Na}^+$ to flow into the axon;<br>c. (during repolarization) $\text{K}^+$ channels open;<br>d. allowing $\text{K}^+$ to flow out of the axon;<br>e. the $\text{Na}^+/\text{K}^+$ pump returns the (axon) membrane to the resting potential;<br>f. by moving $3\text{Na}^+$ out and $2\text{K}^+$ in;                                                                                                                        |  | 4 |

(continued...)

– 17 –

SPEC/4/BIOLO/HP2/ENG/TZ0/XX/M

(Question 8 continued)

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Notes | Total |
|----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 8.       | c | a. courtship behaviour is often complex and unique to a species;<br>b. (at several stages in courtship ritual) rejection occurs if characteristic behaviour not exhibited;<br>c. species-specific egg fertilization;<br>d. compatibility of acrosome with vitelline layer;<br>e. inability of successfully attached wrong species sperm to develop continuity with egg membrane;<br>f. sterility of interspecific hybrids;<br>g. due to differences in chromosome number; |       | 4     |

– 18 –

SPEC/4/BIOLO/HP2/ENG/TZ0/XX/M

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Populations and communities

14 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q36 | 1 marks

36.          B

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                   |          |
|----|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------|
| 2. | a | <p>a. the crocodile feeds on three different species of animals / <i>OWTTE</i>;</p> <p>b. the crocodile can be a tertiary consumer while cormorant/tigerfish is a secondary consumer<br/><b>OR</b></p> <p>c. the crocodile has a <u>higher trophic level</u> than both the cormorant and tigerfish / <i>vice versa</i>;</p> <p>d. DDT doesn't break down/biodegrade/metabolize<br/><b>OR</b></p> <p>(bio)accumulates/builds up (in the fat/adipose tissues/crocodile);</p> <p>d. accumulation/biomagnification of DDT in the higher/across trophic levels;</p> | <p>c. Do not award this marking point for "accumulates in the food chain".</p> <p>d. Trophic levels required.</p> | 2<br>max |
| 2. | b | <p>a. kapenta;</p> <p>b. has the lowest levels of DDT;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                   | 2        |

– 7 –

2225 – 6014

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Notes                                                                                                                                                   | Total    |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 2. c     | <p>a. use the <u>capture-mark-release-recapture</u> method<br/><b>OR</b></p> <p>use the Lincoln index method;</p> <p>b. (random) sample is captured and marked/tagged (in a manner that will not harm the fish/tilapia);</p> <p>c. captured sample is released (and allowed to mix with general population);</p> <p>d. (after a period of time) second sample is captured and both the total number and the number of marked fish/tilapia counted/<i>OWTTE</i>;</p> <p>e. correct formula / description of formula;</p>            |                                                                                                                                                         | 3<br>max |
| 2. d     | <p><b>Impact: [2 max]</b></p> <p>a. overfishing can disrupt food chains/webs/ecosystems;</p> <p>b. named example from the diagram;</p> <p>c. decrease biodiversity / <i>OWTTE</i>;</p> <p><b>Assessing: [2 max]</b></p> <p>d. monitoring/measuring that the rate of harvesting of species is lower than the rate of replacement of species/<i>OWTTE</i>;</p> <p>e. monitoring/enforcing application of regulations;</p> <p>f. monitoring population size (over time)<br/><b>OR</b></p> <p>monitoring biodiversity (over time);</p> | <p>e. Accept monitoring of regulations, e.g., size/age of fish, number in a catch, mesh size of nets, quotas, etc., but not setting of regulations.</p> | 4<br>max |

– 8 –

2225 – 6014

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                 |   |
|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---|
| 1. | a | 250 mg L <sup>-1</sup> ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <i>Units required</i><br><i>Accept values from 240 to 260 mg L<sup>-1</sup></i> | 1 |
| 1. | b | when mussels are absent cyanobacteria increases over time and when they are present, they decrease;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <i>Or vice versa.</i>                                                           | 1 |
| 1. | c | increasing in number as the cyanobacteria/phytoplankton were reproducing/growing;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                 | 1 |
| 1. | d | <p><i>Similarity</i></p> <p>a. both cause a reduction in the amount of chlorophyll in the water<br/><b>OR</b><br/>after 12/24/value between 12 and 24 there is no/little removal of chlorophyll/similar chlorophyll concentration;</p> <p><i>Difference</i></p> <p>b. rate of removal increases more/ faster at 0.5 mgL<sup>-1</sup> between 4 and 8 hours /overall rate of removal in the first 8 hours is faster for 0.5 mgL<sup>-1</sup>;<br/><b>OR</b><br/>rate of removal levels off earlier at 0.5 mgL<sup>-1</sup> / mussel filtration more effective in the first 8 hours at 0.5 mgL<sup>-1</sup> than filtration at 0.9 mgL<sup>-1</sup>;</p> | <i>or vice versa</i>                                                            | 2 |

– 6 –

2225 – 6009M

| Question |    | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Notes                                                           | Total    |
|----------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|----------|
| 1.       | e  | 33(%);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <i>Accept 30 to 36</i>                                          | 1        |
| 1.       | f. | <p>a. 1964 as <i>A. anatine</i> is in similar percentages;</p> <p>b. 1964 as <i>P. complanate</i> are present;</p> <p>c. other valid reason;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                 | 1<br>max |
| 1        | g  | <p>a. the data does not provide population numbers / percentage does not represent population;</p> <p>b. the % has increased;</p> <p>c. the overall population may have decreased / even though the percentage is higher, there may have been a decrease in population;</p>                                                                                                                                                                                                                                                                                                                                                       |                                                                 | 2<br>max |
| 1.       | h  | 50(%);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                 | 1        |
| 1.       | i  | <p><i>Similarities</i></p> <p>a. both showed a decrease in density (at all depths) from 1964 to 2020<br/><b>OR</b><br/>both have the greatest decrease/change between 0-1m;</p> <p><i>Differences</i></p> <p>b. at all depths the decrease in <i>U. pictorum</i> density was greater than <i>U. tumidus</i><br/><b>OR</b><br/><i>U. tumidus</i> only shows major decrease at 0-1m depth /shows only small decreases at 1-4m while <i>U. pictorum</i> shows great change/almost 0 at all depths<br/><b>OR</b><br/><i>U. tumidus</i> shows greater variation/possible overlap of values/range of error than <i>U. pictorum</i>;</p> | <i>Award 1 mark for a similarity, another for a difference.</i> | 2        |

| Question |   |  | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Notes | Total |
|----------|---|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 1.       | j |  | <p>a. (the first piece of data shows) that mussels improved water quality because they <u>filtered</u> / quality goes down when mussels are absent <u>and cannot filter</u>;</p> <p>b. (the second piece of data) shows changes in the distribution of mussels over time so water quality may be changing</p> <p><b>OR</b></p> <p>the distribution changes indicate that the water quality became more suitable for some mussels and less suitable for others;</p> <p>c. (the third piece of data shows) shows a decrease in the number/density over time and that might indicate lower survival rates due to poor water quality</p> <p><b>OR</b></p> <p>decrease in the number/density of mussels over time indicates cleaner water/less food (because there is no need for filtering);</p> <p>d. other factors/legislation may lead to changes in water quality</p> <p><b>OR</b></p> <p>not only the quantity of mussels determines water quality;</p> |       | 2 max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                      |          |
|----|---|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------|
| 3. | a | i  | mutualism;                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                      | 1        |
| 3. | a | ii | a. (fungi provide) nutrients/water/C resources/P/N;<br>b. (fungi required for) seed germination as orchid seeds lack stored resources;                                                                                                                                                                                                                                                                                        |                                                                                      | 1        |
| 3. | b |    | a. allelopathy uses secondary metabolites/chemicals/allelopathic agents to impact other (nearby) plants;<br>b. named plant with action;<br>c. prevents germination/growth/reproduction of other plants / is toxic to other plants / other verified result;<br>d. increases the resources (soil/water/sunlight/etc.) available for growth/survival/reproduction;<br>e. may impact plant community structure / become invasive; | Question asks for a named example.<br>Maximum of 2 marks if an example is not given. | 3<br>max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |    |                                                                                                                                                                                          |  |       |
|----|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|
| 5. | a |    | population;                                                                                                                                                                              |  | 1     |
| 5. | b |    | a. competition for/taking/blocking/limiting access to light/sun;<br>b. competition for/taking/limiting supplies of water/nutrients (from the soil);<br>c. allelopathy/release of toxins; |  | 2 max |
| 5. | c | i  | mutualism;                                                                                                                                                                               |  | 1     |
| 5. | c | ii | herbivory / heterotrophic nutrition / (primary) consumer;                                                                                                                                |  | 1     |

– 11 –

2225 – 6021

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q36 | 1 marks

36.          A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q39 | 1 marks

39.          D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q36 | 1 marks

36.          B

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                            |       |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------|
| 1. | a | 2016;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                            | 1     |
| 1. | b | <p><i>Similarities</i></p> <p>a. the numbers fluctuate/vary for each species from year to year;</p> <p>b. both ended with a higher number of nests compared to the initial value/first year of survey;</p> <p><i>Differences 2 max</i></p> <p>c. every year there are more loggerhead nests than green turtle nests;</p> <p>d. the (overall) trend for green turtles is an increase and for loggerhead turtles (a relatively) constant number of nests (with a dip in the middle years)/ small fluctuations/changes over the years</p> <p><b>OR</b></p> <p>green turtles had a greater increase (in number of nests) during the survey than loggerhead turtles;</p> <p>e. green turtles tend to come ashore (roughly) every other year to nest but no trend for loggerhead turtles</p> <p><b>OR</b></p> <p>in some years / named years there were no nests at all for green turtles only;</p> | <p><i>Comparative terms are expected. Do not award points for just stating values.</i></p> | 3 max |

| Question |    | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Notes                                                                                                     | Total |
|----------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------|
| 1.       | c  | <p>a. (may be inaccurate as) it does not include male turtles;</p> <p>b. (young or old) turtles which are not nesting are not counted / not all turtles are at reproductive age;</p> <p>c. no information is provided about how often they nest / criteria for selecting beaches;</p> <p>d. not all nests are counted/found/identified;</p> <p>e. unknown number of eggs / neonatal mortality / not all newborn turtles survive / make it to the ocean;</p> | <p><i>Do not award a marking point for vague statements such as turtles at sea not being counted.</i></p> | 2 max |
| 1.       | d  | <i>Chelonia mydas</i> /Green;                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                           | 1     |
| 1.       | e  | <p>a. occupy different habitats / live in different areas / different migration patterns</p> <p><b>OR</b></p> <p>swim/forage at different depths;</p> <p>b. some samples are small, so not representative</p> <p><b>OR</b></p> <p>the larger the population may lead to more chances of VSI;</p>                                                                                                                                                            |                                                                                                           | 1 max |
| 1.       | f. | as (mean annual) number of vessels increase (the proportion of stranded sea turtles with a) VSI increase / positive correlation;                                                                                                                                                                                                                                                                                                                            | <p><i>Do not accept “directly proportional” or “positive relationship”</i></p>                            | 1     |

| Question |   |  | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Notes                                                                                                                                                                                                                  | Total    |
|----------|---|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1.       | g |  | a. too many turtles with VSI for (low) number of vessels;<br>b. too few vessels for the (high) number of turtles with VSI;                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <i>Do not accept outlier on its own or just values. Clear indication to relationship between vessels and turtles with VSI required.</i>                                                                                | 1<br>max |
| 1.       | h |  | a. (evidence shows that) increased number of vessels increases turtle injuries;<br>b. no evidence that VSI results in death / vessel injuries (VSI) may not result in death;<br>c. no information is given about other reasons turtles die (in Florida) / causes of death;<br>d. no information provided on total number / percentage of deaths;<br>e. evidence from the table shows that vessel injury accounts for damage to less than half/50% of (stranded) turtles<br><b>OR</b><br>evidence from the table shows that vessel injury accounts for maximum 34.4% (of stranded turtles); | <i>For c. do not accept that other factors ARE the main cause of death (no evidence for this). Stranded includes dead, sick or injured.</i><br><br><i>For e. (first strand) allow any value between 50% and 34.4%.</i> | 3<br>max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |       |
|----|---|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------|
| 7. | a |   | <p>a. X is more closely related to <i>M. luminyensis</i>;</p> <p>b. smaller number of nodes/closer node between two clades/ species</p> <p><b>OR</b></p> <p>more <u>recent</u> common ancestor (with <i>M. luminyensis</i>) / common ancestor between X and <i>E. faecalis</i> is more <u>distant</u> (than with <i>M. luminyensis</i>)</p> <p><b>OR</b></p> <p>X and <i>E. faecalis</i> belong to different clades / X and <i>M. luminyensis</i> belong to the same clade;</p> | <p><i>For b. OWTTE.</i></p> <p><i>For b. accept 'branching point' for node.</i></p> | 2     |
| 7. | b | i | <p>a. has a disproportionate/large effect (on the community);</p> <p>b. they maintain/regulate populations of other species</p> <p><b>OR</b></p> <p>they maintain species diversity/biodiversity</p> <p><b>OR</b></p> <p>the removal of the keystone species decreases species diversity/biodiversity of the ecosystem;</p> <p>c. the removal of the keystone species can lead to collapse of the ecosystem;</p>                                                                | <i>Do not accept examples.</i>                                                      | 2 max |

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| Question |   |    | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Notes                                                                                                                                          | Total |
|----------|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 7.       | b | ii | <p>a. climax community occurs after succession has ended / the gut community has all its characteristics/stabilized / a stable/persistent ecosystem has been reached;</p> <p>b. antibiotics stop division/kill some <u>species</u> of gut bacteria</p> <p><b>OR</b></p> <p>antibiotics can kill beneficial as well as harmful bacteria</p> <p><b>OR</b></p> <p>antibiotics reduce bacterial population sizes;</p> <p>c. antibiotics decrease biodiversity/species richness;</p> <p>d. competition occurs to establish a new climax community;</p> <p>e. variation in antibiotic resistance among (gut) bacteria / some species may develop tolerance/resistance to the antibiotic;</p> | <p><i>For b. do not award points for simple statements of antibiotics killing bacteria.</i></p> <p><i>For e. do not accept "immunity".</i></p> | 2 max |
| 7.       | c |    | <p>bacteria reproduce asexually/by binary fission</p> <p><b>OR</b></p> <p>(different species of) bacteria can exchange genetic material by horizontal gene transfer</p> <p><b>OR</b></p> <p>genes can be transferred from one species to another;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><i>Accept bacteria do not reproduce sexually or do not interbreed.</i></p>                                                                  | 1     |

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8825 – 6021M

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q37 | 1 marks

37.        A

Biology HL | Paper 1A | Specimen 2025 | Q38 | 1 marks

38.        C

|                                                                    |                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |          |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
|--------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|------------|------------|--------------|-------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------|---------------|----------------|-------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 3.                                                                 | a                                                                    | a. symbiotic relationship between two (unrelated) species<br><b>OR</b><br>to the benefit of both species;<br>b. bacteria get organic molecules <b>AND</b> plant gets nitrates;                                                                                                                                                                                                                                                                   |                  | 2        |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| 3.                                                                 | b                                                                    | <table><tr><td><i>Rhizobium</i></td><td>Fabaceae</td></tr><tr><td>prokaryote</td><td>eukaryote;</td></tr><tr><td>circular DNA</td><td>linear DNA/chromosomes;</td></tr><tr><td>membrane bound organelles<br/>absent<br/>(accept a specific example)</td><td>membrane bound organelles<br/>present;<br/>(accept a specific example)</td></tr><tr><td>70S ribosomes</td><td>80S ribosomes;</td></tr><tr><td>small</td><td>large;</td></tr></table> | <i>Rhizobium</i> | Fabaceae | prokaryote | eukaryote; | circular DNA | linear DNA/chromosomes; | membrane bound organelles<br>absent<br>(accept a specific example) | membrane bound organelles<br>present;<br>(accept a specific example) | 70S ribosomes | 80S ribosomes; | small | large; | Some form of distinction <b>MUST</b> be made.<br>e.g. ' <i>Rhizobium</i> is small' would be insufficient. However, 'smaller' implies a distinction | 2 |
| <i>Rhizobium</i>                                                   | Fabaceae                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |          |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| prokaryote                                                         | eukaryote;                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |          |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| circular DNA                                                       | linear DNA/chromosomes;                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |          |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| membrane bound organelles<br>absent<br>(accept a specific example) | membrane bound organelles<br>present;<br>(accept a specific example) |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |          |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| 70S ribosomes                                                      | 80S ribosomes;                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |          |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| small                                                              | large;                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |          |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| 3.                                                                 | c                                                                    | distantly related species are more likely to have different characteristics/metabolisms (so are more likely to provide for each others' requirements)                                                                                                                                                                                                                                                                                            |                  | 1        |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |
| 3.                                                                 | d                                                                    | a. with additional nitrate, nodule size does not change/remains small;<br>b. without additional nitrate, nodule size increases (over time);<br>c. (suggests that) nitrate inhibits nodule growth;<br>d. when nitrate is scarce, nodule growth ensures nitrate supply from a larger bacterial population;<br>e. (suggests that) mutualism is affected by environmental conditions;                                                                |                  | 3        |            |            |              |                         |                                                                    |                                                                      |               |                |       |        |                                                                                                                                                    |   |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |    |                                                                                                                                                                                                                        |  |   |
|----|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 5. | a |    | ensures a habitat is sustainable for the prey/limits damage to the ecosystem (as a result of overpopulation)/removes genetically weaker individuals/prevents overgrazing/prevents overpopulation                       |  | 1 |
| 5. | b |    | a. the size of the predator population (influences the prey population);<br>b. resources/food may be limiting;<br>c. transfer of pathogens/pests/disease (influences the prey population);                             |  | 2 |
| 5. | c | i  | a. sample captured, marked and released;<br>b. ratio of marked individuals in a second sample determined;<br>c. equals ratio of marked sample to entire population/use Lincoln index;                                  |  | 2 |
| 5. | c | ii | a. low levels of immigration/emigration between sampling events;<br>b. distribution/mortality/survival not affected by capture/markings;<br>c. trap avoidance minimal;<br>d. reproduction patterns/rates not affected; |  | 1 |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Transfers of energy and matter

10 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q37 | 1 marks

37.          C  

Biology HL | Paper 1A | May 2025 TZ2 | Q37 | 1 marks

37.          D  

Biology HL | Paper 1A | May 2025 TZ3 | Q35 | 1 marks

35.          B  

Biology HL | Paper 1A | May 2025 TZ3 | Q40 | 1 marks

40.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q37 | 1 marks

37.          B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q35 | 1 marks

35.          C  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q37 | 1 marks

37.          B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q40 | 1 marks

40.          B

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                      |       |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 4. | a | photosynthesis;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Allow Calvin cycle                                                                                                                                                                                                                                                   | 1     |
| 4. | b | a. biomass/trees/timber/forests;<br>b. coal;<br>c. limestone;<br>d. natural gas/methane (reserves);<br>e. oil;<br>f. peat/peatland/peat bogs/swamps;<br>g. permafrost;<br>h. soil;                                                                                                                                                                                                                                                                                                                                                                                        | Accept first two answers only.<br>Answers that are not accepted:<br>plants/phytoplankton (as they may be small/short-lived).<br>fossils/fossil fuels unless a specific fossil fuel is named.<br>air in the atmosphere or bubbles in ice.<br>decomposers/saprotrophs. | 2 max |
| 4. | c | a. combustion of fossil fuels/named fuel;<br>b. less uptake of carbon dioxide / less photosynthesis / loss of carbon sink due to deforestation<br><b>OR</b><br>forest fires / combustion of forests;<br>c. release of carbon (dioxide) from increased decomposition/increased activity of saprotrophs/bacteria/fungi (due to anthropogenic global warming)<br><b>OR</b><br>release of carbon (dioxide) due to drainage of wetlands (and decomposition of peat)<br><b>OR</b><br>release of carbon (dioxide) from melting permafrost (due to anthropogenic global warming); | Do not award mark point b for just 'deforestation'.                                                                                                                                                                                                                  | 2 max |

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| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q35 | 1 marks

35.          C

APOLLO

# DNA replication

6 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q9 | 1 marks

9.       C  

Biology HL | Paper 1A | May 2025 TZ2 | Q9 | 1 marks

9.       B

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                         |  |       |
|----|---|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|
| 3. | a |    | DNA / deoxyribonucleic acid / deoxyribo(nucleic acid) / deoxyribose (nucleic acid);                                                                                                                                                                                                                                                                                     |  | 1     |
| 3. | b |    | replication because the base shown (on the new strand) is T/thymine / is not U/uracil;                                                                                                                                                                                                                                                                                  |  | 1     |
| 3. | c |    | cytosine / C;                                                                                                                                                                                                                                                                                                                                                           |  | 1     |
| 3. | d |    | 5' (terminal);                                                                                                                                                                                                                                                                                                                                                          |  | 1     |
| 3. | e | i  | covalent/phosphodiester;                                                                                                                                                                                                                                                                                                                                                |  | 1     |
| 3  | e | ii | a. (DNA) <u>polymerase</u> adds nucleotides (to the template strand) / makes a new strand (of nucleotides)<br><b>OR</b><br><u>DNA polymerase III</u> (adds nucleotides) with complementary bases/ makes base pairs;<br>b. DNA polymerase I removes the RNA primer replacing it with DNA;<br>c. (DNA) ligase joins Okazaki/DNA fragments / seals gaps between fragments; |  | 2 max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ3 | Q10 | 1 marks

10.       D  

Biology HL | Paper 1A | Specimen 2025 | Q3 | 1 marks

3.         A  

Biology HL | Paper 1A | Specimen 2025 | Q9 | 1 marks

9.         B

APOLLO

# Protein synthesis

7 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q10 | 1 marks

10.       B  

Biology HL | Paper 1A | May 2025 TZ2 | Q10 | 1 marks

10.       C  

Biology HL | Paper 1A | May 2025 TZ3 | Q11 | 1 marks

11.       A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q10 | 1 marks

10.       D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q9 | 1 marks

9.         C  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q20 | 1 marks

20.         D  

Biology HL | Paper 1A | Specimen 2025 | Q11 | 1 marks

11.       D

APOLLO

# Mutation and gene editing

9 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q11 | 1 marks

11.     A

Biology HL | Paper 1A | May 2025 TZ2 | Q11 | 1 marks

11.     B

Biology HL | Paper 1A | May 2025 TZ2 | Q27 | 1 marks

27.     A

Biology HL | Paper 1A | May 2025 TZ3 | Q10 | 1 marks

10.     A

Biology HL | Paper 1A | May 2025 TZ3 | Q19 | 1 marks

19.     B

Biology HL | Paper 1A | Nov 2025 TZ1 | Q11 | 1 marks

11.     A

Biology HL | Paper 1A | Nov 2025 TZ3 | Q11 | 1 marks

11.     C

Biology HL | Paper 1A | Nov 2025 TZ3 | Q22 | 1 marks

22.     B

|     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                           |   |
|-----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---|
| 10. | a | <ul style="list-style-type: none"> <li>a. affects/damages/causes change in oncogenes/errors in DNA repair;</li> <li>b. UV radiation might alter complementary base pairing/break hydrogen bonds/fuse bases;</li> <li>c. double helix may uncoil;</li> <li>d. strands may separate/break;</li> <li>e. DNA sequence may be altered/DNA bases may re-connect to different bases after separating;</li> <li>f. DNA strand may break into pieces / fragments of DNA may be lost;</li> </ul>                                                                                                                                                              |                                           | 4 |
| 10. | b | <ul style="list-style-type: none"> <li>a. DNA base sequence provides information;</li> <li>b. gene expression / genes provides a template for the construction of a protein;</li> <li>c. transcription occurs / mRNA is built using DNA as a template;</li> <li>d. DNA nucleotide structure described/sugar and phosphate and base;</li> <li>e. polymer of nucleotides makes a DNA strand;</li> <li>f. DNA has two anti-parallel strands;</li> <li>g. complementary base pairs/A pairs with T and C with G;</li> <li>h. strands linked by hydrogen bonding between bases;</li> <li>i. double helix shape / helix held by hydrogen bonds;</li> </ul> | Accept points in clearly labelled diagram | 7 |
| 10. | c | <ul style="list-style-type: none"> <li>a. gene knockout technology is a genetic engineering technique/intentional alteration in the sequence of a gene;</li> <li>b. making a gene inactive;</li> <li>c. using site specific nucleases / CRISPR;</li> <li>d. researcher observes changes in phenotype of organism;</li> <li>e. allows researcher to determine function of the gene;</li> <li>f. entire library of knockout organisms exists;</li> <li>g. made available to researchers;</li> </ul>                                                                                                                                                   |                                           | 4 |

APOLLO

# Cell and nuclear division

9 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q19 | 1 marks

19.          D  

Biology HL | Paper 1A | May 2025 TZ1 | Q22 | 1 marks

22.          A  

Biology HL | Paper 1A | May 2025 TZ2 | Q19 | 1 marks

19.          B  

Biology HL | Paper 1A | May 2025 TZ2 | Q30 | 1 marks

30.          D

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                |       |
|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 8. | a | <p>a. cell walls are found in plant cells but not in animal cells;</p> <p>b. vacuoles are large in plant and small in animal cells;</p> <p>c. chloroplasts/plastids present in plants but not in animals cells;</p> <p>d. centrioles present in animal cells but not in plant cells;</p> <p>e. cilia/flagella present in (some) animal cells but not in plant cells;</p> <p>f. lysosomes present in animal cells but not in plant cells;</p>                                                                                                                                                                                                                                                                             | <p><i>Accept answers in a table format.</i></p> <p><i>Note: There must be a clear difference between the 2 types of cells.</i></p> <p><i>Accept clearly annotated diagrams if the differences are evident and help to distinguish between the 2 cells.</i></p> | 3 max |
| 8. | b | <p>a. (some) herbivores have piercing/chewing/jaw-like/modified mouthparts/teeth/tough mandibles to eat/chew leaves<br/><b>OR</b><br/>(some) herbivores have proboscis to suck nectar;</p> <p>b. (some) herbivores/ruminants have different stomachs/cellulase to digest plant/cellulose;</p> <p>c. (some) herbivores detoxify plant toxins;</p> <p>d. (some) plants resist herbivory using/by the presence of (sharp) thorns/spines/spikes/other physical structures;</p> <p>e. (some) plants have stings to cause pain/burning sensations / bad/unpleasant taste;</p> <p>f. (some) plants produce toxins/toxic chemicals/(secondary) compounds/metabolites (in seeds and leaves) to avoid predation by herbivores;</p> | <p><b>Max 2 for herbivores and Max 2 for plants.</b></p>                                                                                                                                                                                                       | 4 max |

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2225 – 6015

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Notes                                                                                 | Total |
|----------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------|
| 8.       | c | <p><b>Similarities: [6 max]</b></p> <p>a. (in both plants and animals) produces two <u>genetically</u> identical daughter cells;</p> <p>b. maintains the chromosome number/genome of cell / produces diploid/2n cells;</p> <p>c. used for generation of new cells/cell replacement/tissue repair/growth;</p> <p>d. in prophase the chromatin/chromosome condenses/formation of chromatids/supercoiling of chromosomes;</p> <p>e. supercoiling of DNA around histones (to form nucleosomes);</p> <p>f. microtubules/microtubule motors to move chromosomes/chromatids;</p> <p>g. in metaphase chromosomes align in equator of cell;</p> <p>h. in anaphase separation of chromatids;</p> <p>i. in telophase two nuclei/cells form / nuclear membrane/envelope reforms</p> <p><b>OR</b></p> <p>cytokinesis is the division into two cells;</p> <p><b>Differences:</b></p> <p>j. in animal cell centrosomes/centrioles facilitates the organization of the mitotic spindle/ spindle poles/microtubules;</p> <p><b>Marking points for 8c continued on next page....</b></p> | <p><b>Max 6 for similarities.</b></p> <p><i>Allow clearly annotated diagrams.</i></p> | 8 max |

8c continued ....

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| 8. | c | <p>k. in plant cells spindle fibres attach to walls;</p> <p>l. in animal cells, the plasma membrane is pulled inwards around the equator to form a cleavage furrow in cytokinesis</p> <p><b>OR</b></p> <p>in animal cells actin and myosin pinch cell membrane to split cytoplasm/cytokinesis;</p> <p>m. in plant cells a cell plate forms (at the equator) to develop into the new cell wall to achieve cytokinesis</p> <p><b>OR</b></p> <p>in plant cell vesicles (containing pectin) assemble sections of membrane/cell wall (at/across the equator) to achieve splitting/cytokinesis;</p> |  |  |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|

|          |         |       |       |
|----------|---------|-------|-------|
| Question | Answers | Notes | Total |
|----------|---------|-------|-------|

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |              |
|----|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------|
| 8. | a | <p>a. meiosis halves the chromosome number / allows production of haploid gametes/cells;</p> <p>b. fusion of gametes/fertilization doubles (the chromosome number) / <math>n + n = 2</math>;</p> <p>c. meiosis prevents chromosome number doubling/conserves the chromosome number (between generations);</p> <p>d. fusion of gametes brings together genes/alleles/chromosomes from two parents;</p> <p>e. meiosis breaks up combinations of alleles/genes / segregation of alleles</p> <p><b>OR</b></p> <p>meiosis generates variation by independent assortment/crossing over;</p> <p>f. fusion of gametes/fertilization/meiosis produces variation needed for natural selection/evolution/resilience/survivability/<i>OWTTE</i>;</p> |  | <b>4 max</b> |
|----|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------|

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2225 – 6021

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Notes | Total        |
|----------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|
| 8.       | b | <p>a. DNA replication / DNA is duplicated/copied;</p> <p>b. during S-phase of interphase</p> <p><b>OR</b></p> <p>DNA polymerase replicates/makes new DNA strands;</p> <p>c. each chromosome with two identical/sister chromatids/DNA molecules after replication/at start of mitosis;</p> <p>d. cell cycle controlled by cyclins / checkpoints with control by cyclins;</p> <p>e. chromosomes/chromatids/DNA condenses/coils/supercoils (at the start of mitosis/in prophase);</p> <p>f. microtubules/spindle attaches to the kinetochores/centromeres (in metaphase)</p> <p><b>OR</b></p> <p>in metaphase chromosomes are lined up/aligned on equator;</p> <p>g. kinetochores shorten/remove tubulin from (spindle) microtubules;</p> <p>h. cohesin molecules (binding sister chromatids together) break</p> <p><b>OR</b></p> <p>centromeres divide;</p> <p>i. (sister) chromatids/chromosomes) pulled to (opposite) poles/ends/sides (in anaphase);</p> <p>j. nuclear membranes reform (in telophase);</p> <p>k. cytokinesis (at the end of mitosis);</p> <p>l. (mitosis/cell division/cytokinesis) produces two (daughter) cells with the same chromosome number as the original cell/maintains diploid chromosome number;</p> |       | <b>7 max</b> |

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## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q19 | 1 marks

19.          B  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q19 | 1 marks

19.          A  

Biology HL | Paper 1A | Specimen 2025 | Q23 | 1 marks

23.          A

APOLLO

# Gene expression

5 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ2 | Q20 | 1 marks

20.      A

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                     |       |
|----|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------|
| 1. | a |    | 235 / 235.0 / 235.00 (g);                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                     | 1     |
| 1. | b | i  | negative correlation / inverse relationship / higher expression (of WIF1) with lower wool production / higher wool production with lower expression (of WIF1);                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                     | 1     |
| 1. | b | ii | a. there could be a causal relationship because there is a (negative) correlation / <i>OWTTE</i> ;<br>b. correlation does not prove/show causation;<br>c. no mechanism shown for/no explanation of (how expression of WIF1 affects hair growth);<br>d. wool growth may be affected by other factors/(expression of) other genes;<br>e. data is only for two levels of wool production/intermediate values not shown;<br>f. not an experiment/variables not manipulated experimentally/ <i>OWTTE</i> (so causal relationship not shown); | <i>Do not award marks for answers that state unequivocally that there is a causal relationship.</i> | 2 max |
| 1. | c |    | pcDNA / (control is the) plasmid/DNA without the WIF1 gene;                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                     | 1     |
| 1. | d |    | a. no significant effect on EGF expression<br><b>OR</b><br>(small) increase in (mean) EGF expression but error bars overlap/difference is not statistically significant/is not within 0.01 confidence/99% confidence;<br>b. SFR2 (expression) is increased/promoted (by pcDNA-WIF1);<br>c. CCND1 (expression) is decreased/inhibited (by pcDNA-WIF1);                                                                                                                                                                                   |                                                                                                     | 3     |

– 6 –

2225 – 6021

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Notes                                                                                                                                                                                                                                | Total |
|----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1.       | e | a. apoptosis is increased by pcDNA-WIF1 / by WIF1;<br>b. proliferation is decreased by pcDNA-WIF1 / by WIF1;<br>c. increased apoptosis/decreased proliferation of (dermal papilla) cells decreases wool/hair growth;<br>d. protein produced by expressing WIF1 affects/promotes/inhibits expression of other genes;<br>e. (increased) expression of SFRP2 could cause apoptosis/prevent proliferation;<br>f. expression of CCND1 could prevent apoptosis/cause proliferation<br><b>OR</b><br>reduced expression of CCND1 (caused by WIF1) could allow apoptosis/reduce proliferation; | <i>Accept the converse in a. and b. (effects on apoptosis or cell proliferation of absence of WIF1)</i><br><i>Accept the converse in e. and f. (effects on apoptosis or cell proliferation of non-expression of SFRP2 and CCND1)</i> | 4 max |

– 7 –

2225 – 6021

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ3 | Q32 | 1 marks

32.        B  

Biology HL | Paper 1A | Specimen 2025 | Q10 | 1 marks

10.        B  

Biology HL | Paper 1A | Specimen 2025 | Q19 | 1 marks

19.        A

APOLLO

# Water potential

6 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q20 | 1 marks

20.          C  

Biology HL | Paper 1A | May 2025 TZ3 | Q20 | 1 marks

20.          B

|    |   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                      |       |
|----|---|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------|
| 2. | a |   | into the cell/cytoplasm / in / inwards;                                                                                                                                                                                                                                                                                                                                                                                                         |                      | 1     |
| 2. | b | i | a. cells injected with mRNA have (more) aquaporins (in the membrane);<br>b. aquaporins transport water by <u>osmosis</u><br><b>OR</b><br>down the <u>water potential</u> gradient / from high to low <u>water potential</u><br><b>OR</b><br>from hypotonic to hypertonic solution;<br>c. aquaporins (are protein channels) facilitate the uptake of water;<br>d. increased/excess water uptake causes cell size to increase/(ultimately) burst; | a. Allow vice versa. | 2 max |

– 6 –

2225 – 6020

| Question |   |    | Answers                                                                                                                                                                                                                                                                                               | Notes                                                                                                                                     | Total |
|----------|---|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2.       | b | ii | a. ADH is secreted (by the pituitary gland);<br>b. aquaporins released from intracellular vesicles;<br>c. aquaporins inserted into the <u>plasma</u> membrane;<br>d. more water reabsorbed (into blood) / water content of blood increased;<br>e. more concentrated urine produced;                   | e. Do not accept smaller volume of urine.                                                                                                 | 3 max |
| 2.       | c |    | eggs will be of different initial volumes/sizes/shape;                                                                                                                                                                                                                                                | OWTTE<br>Answers should include both the idea of different and initial/starting/beginning volume.<br>Ignore fair test or fair comparison. | 1     |
| 2.       | d |    | the investigation is reliable as it was repeated 10 times / there were multiple trials/readings<br><b>OR</b><br>the investigation is not reliable as there were not enough trials / 10 trials may not be enough<br><b>OR</b><br>reliability cannot be assessed as no error bars / standard deviation; |                                                                                                                                           | 1     |

| Question |   |  | Answers                                                                                                                                                                                                                                                                                                    | Notes                                                                                                            | Total |
|----------|---|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------|
| 2.       | e |  | <p>a. (time required for) assembly of ribosomal-mRNA complex;</p> <p>b. mRNA must be translated;</p> <p>c. post-translational modifications are necessary</p> <p><b>OR</b></p> <p>valid example of modification;</p> <p>d. protein needs to be transported to (and inserted into) the plasma membrane;</p> | <p><i>b. Do not award if transcription is mentioned.</i></p> <p><i>b. Accept description of translation.</i></p> | 2 max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q20 | 1 marks

20.          D

| 4.        | a                  | <p>a. (when cell is placed in a hypotonic solution) surrounding/outside (of the root hair cell) is more dilute / has higher water potential</p> <p><b>OR</b></p> <p>water will enter the root hair cell</p> <p><b>OR</b></p> <p>water moves from high water potential to low water potential;</p> <p>b. (positive) pressure potential will increase / become more positive;</p> <p>c. (negative) solute/osmotic potential will increase / become less negative;</p> <p>d. water potential inside the cell will increase / become less negative;</p> <p>e. <math>\Psi_w = \Psi_s + \Psi_p</math>;</p> <p>f. when cell's water potential equals that of the solution, (net) water movement stops;</p> | <p>For e. allow word equation:</p> <p><math>\Psi_w</math> = water potential</p> <p><math>\Psi_s</math> = solute potential</p> <p><math>\Psi_p</math> = pressure potential</p>                                                                                                                                                                                         | 3<br>max                                                                        |                    |       |             |           |            |                                                                                                  |   |
|-----------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------|-------|-------------|-----------|------------|--------------------------------------------------------------------------------------------------|---|
| 4.        | b                  | i                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>a. uptake of mineral ions into root;</p> <p>b. root cells transport mineral ions into the <u>xylem</u>;</p> <p>c. requires active transport/ATP;</p> <p>d. water enters the <u>xylem</u> by osmosis (due to hypertonic/higher solute concentration in xylem sap);</p> <p>e. creates a pressure which pushes water up (the xylem / the stem / against gravity);</p> | <p>Do not accept “capillary action” or answers referring to “transpiration”</p> | 2<br>max           |       |             |           |            |                                                                                                  |   |
| 4.        | b                  | ii                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <table><tr><th>Hormone</th><th>Site of production</th></tr><tr><td>Auxin</td><td>Shoot (tip)</td></tr><tr><td>Cytokinin</td><td>Root (tip)</td></tr></table>                                                                                                                                                                                                          | Hormone                                                                         | Site of production | Auxin | Shoot (tip) | Cytokinin | Root (tip) | <p>Award 1 mark per row.</p> <p>If 0 marks awarded, allow 1 mark if both hormones are named.</p> | 2 |
| Hormone   | Site of production |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                       |                                                                                 |                    |       |             |           |            |                                                                                                  |   |
| Auxin     | Shoot (tip)        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                       |                                                                                 |                    |       |             |           |            |                                                                                                  |   |
| Cytokinin | Root (tip)         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                       |                                                                                 |                    |       |             |           |            |                                                                                                  |   |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |    |                                                                                                                                                                                                                                                                                              |                                                                                                       |   |
|----|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---|
| 1. | a | i  | sucrose concentration                                                                                                                                                                                                                                                                        |                                                                                                       | 1 |
| 1. | a | ii | a. surface area;<br>b. varies with size (and shape)<br><b>OR</b><br>is a variable that affects osmosis<br><b>OR</b><br>would have affected the rate of osmosis/diffusion/movement of water into/out of the tissue<br><b>OR</b><br>is a variable that needs to be controlled;                 |                                                                                                       | 2 |
| 1. | b |    | initial masses/size of beetroot pieces were (slightly) different<br><b>OR</b><br>(relative changes in mass allow for a) fair comparison between pieces at different concentrations with (slightly) different initial mass                                                                    |                                                                                                       | 1 |
| 1. | c |    | a. water enters the pieces of beetroot tissue;<br>b. (water enters) by osmosis;<br>c. pressure potential rises;<br>d. increasing the water potential (of the tissue);<br>e. until an equilibrium is reached / no further <b>net</b> movement of water;<br>f. the cells/tissue is/are turgid; | Accept $\psi_s$ for solute potential, $\psi_p$ for pressure potential and $\psi$ for water potential. | 3 |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

APOLLO

# Reproduction

6 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q29 | 1 marks

29.          A  

Biology HL | Paper 1A | May 2025 TZ2 | Q29 | 1 marks

29.          B  

Biology HL | Paper 1A | May 2025 TZ3 | Q30 | 1 marks

30.          A  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q29 | 1 marks

29.          C  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q29 | 1 marks

29.          D  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q30 | 1 marks

30.          C

APOLLO

# Inheritance

10 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q31 | 1 marks

31.          C  

Biology HL | Paper 1A | May 2025 TZ2 | Q31 | 1 marks

31.          B  

Biology HL | Paper 1A | May 2025 TZ2 | Q32 | 1 marks

32.          D  

Biology HL | Paper 1A | May 2025 TZ3 | Q31 | 1 marks

31.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q30 | 1 marks

30.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q31 | 1 marks

31.          D

|    |      |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                      |          |    |    |    |    |      |      |      |      |                                                                                                                                                                                                                            |   |
|----|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|----|----|----|----|------|------|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 6. | a    | <p>a. correct genotypes of parents shown = BbGg and bbgg;</p> <p>b. correct gametes and genotypes of offspring (BbGg + Bbgg + bbGg + bbgg);</p> <table><tr><td></td><td>BG</td><td>Bg</td><td>bG</td><td>bg</td></tr><tr><td>bg</td><td>BbGg</td><td>Bbgg</td><td>bbGg</td><td>bbgg</td></tr></table> <p>c. correct phenotypes - broad, green (leaves): broad, yellow (leaves): narrow, green (leaves): narrow, yellow (leaves);</p> |                      | BG       | Bg | bG | bg | bg | BbGg | Bbgg | bbGg | bbgg | <p>For a. and b. do not accept other letters to represent alleles. Allow use of other letters as ECF for c. only.</p> <p>Accept other types of diagrams.</p> <p>For c. phenotype must match genotype of the offspring.</p> | 3 |
|    | BG   | Bg                                                                                                                                                                                                                                                                                                                                                                                                                                   | bG                   | bg       |    |    |    |    |      |      |      |      |                                                                                                                                                                                                                            |   |
| bg | BbGg | Bbgg                                                                                                                                                                                                                                                                                                                                                                                                                                 | bbGg                 | bbgg     |    |    |    |    |      |      |      |      |                                                                                                                                                                                                                            |   |
| 6. | b    | <p>a. genes for leaf symmetry and colour are linked / on same chromosome / on chromosome 4;</p> <p>b. alleles of these genes fail to assort independently / L and G / l and g inherited together;</p> <p>c. low probability of recombinants being formed;</p> <p>d. recombinants can only occur through <u>crossing over</u>;</p>                                                                                                    | <p>For b. OWTTE.</p> | 2<br>max |    |    |    |    |      |      |      |      |                                                                                                                                                                                                                            |   |

|          |         |       |       |
|----------|---------|-------|-------|
| Question | Answers | Notes | Total |
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q31 | 1 marks

31.          D

|    |   |  |                                                                                                                                                                                                                                                                                                                                                                                                   |  |   |
|----|---|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 6. | a |  | a. pair of sex chromosomes / X and Y chromosomes;<br>b. X and Y sperm produced in equal numbers;<br>c. egg is X and if fertilized by X sperm leads to a female child;<br>d. egg is X and if fertilized by Y sperm leads to a male child;                                                                                                                                                          |  | 2 |
| 6. | b |  | a. sex cell normally contains one copy (of chromosome 21);<br>b. (because of nondisjunction) fail to separate properly;<br>c. in first or second meiotic division;<br>d. sex cell contains two copies (of chromosome 21);<br>e. this sex cell (with two copies) fertilizes normal sex cell (with one copy);<br>f. non-disjunction (of chromosome 21) more frequent in females/increases with age; |  | 3 |
| 6. | c |  | a. mostly males affected;<br>b. sons of affected father are unaffected;<br>c. sons of affected mother are affected;                                                                                                                                                                                                                                                                               |  | 2 |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

|    |   |  |                                                                                                                                                                                                                                                                           |  |   |
|----|---|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 7. | a |  | brown body vestigial wings <b>AND</b> black body, normal wings                                                                                                                                                                                                            |  | 1 |
| 7. | b |  | a. independent assortment predicts 1:1:1:1<br><b>OR</b><br>this (mendelian) ratio not seen / recombinants less frequent/parental types more frequent;<br>b. suggests linkage<br><b>OR</b><br>small numbers so could be a result of differential survival;                 |  | 2 |
| 7. | c |  | a. calculate expected numbers;<br>b. assume no selective advantage to any of the genotypes;<br>c. calculate chi square value;<br>d. (if tabulated value is exceeded then) significant difference/reject null hypothesis/alleles do not sort independently/alleles linked; |  | 2 |

APOLLO

# Homeostasis

7 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q30 | 1 marks

30.          C  

Biology HL | Paper 1A | May 2025 TZ3 | Q32 | 1 marks

32.          C

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |              |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------|
| 8. | a | <p>a. cohesion is caused by the polarity of water<br/><b>OR</b><br/>water molecules have a negative and positive end;</p> <p>b. water molecules are attracted to each other<br/><b>OR</b><br/>water molecules are linked by hydrogen bonds;</p> <p>c. (cohesion) enables transport of water along stems/xylem<br/><b>OR</b><br/>enables a continuous column of water in transpiration/transpiration pull;</p> <p>d. surface tension provides a habitat for some organisms<br/><b>OR</b><br/>some insects can walk on water surface because surface tension/other verified example<br/><b>OR</b><br/>cohesion is related to buoyancy allowing organisms (like ringed seal) to float;</p> <p>e. helps animals regulate body temperature (through evaporative cooling);</p> <p>f. (cohesion causes high specific heat) so maintains a stable temperature in aquatic environments<br/><b>OR</b><br/>water is liquid at a wide range of temperatures supporting many aquatic habitats;</p> |  | <b>4 max</b> |
|----|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------|

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Notes | Total        |
|----------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|
| 8        | b | <p><i>Melting of ice:</i></p> <p>a. can cause loss of habitat;</p> <p>b. can cause loss of breeding grounds /loss of food sources;</p> <p>c. polar bears/walruses/arctic foxes/ snowy owls/reindeer/other example of species affected;</p> <p><i>Changes in ocean current:</i></p> <p>d. may prevent nutrient upwelling / stop nutrients rising to the surface;</p> <p>e. lowers the growth of phytoplankton / ocean primary production;</p> <p>f. disrupts energy flow/food chains/migration patterns of aquatic species;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       | <b>4 max</b> |
| 8        | c | <p>a. negative feedback loops maintain <u>homeostasis</u>/return variables to an original set point if levels are increased or decreased;</p> <p>b. osmoreceptors in the hypothalamus detect if body/blood is dehydrated/hypertonic/solute concentration is too high;</p> <p>c. ADH is secreted if body/blood is dehydrated/hypertonic;</p> <p>d. (ADH is released) from the pituitary;</p> <p>e. (ADH) increases/stimulates more aquaporins / aquaporins open in the collecting duct;</p> <p>f. collecting duct more permeable to water/reabsorbs more water (from filtrate/urine);</p> <p>g. more water is reabsorbed into the blood / blood solute concentration reduced;</p> <p>h. less water lost in urine / smaller volume of (more concentrated) urine;</p> <p>i. increases the concentration of water/ water potential in blood/decreases the concentration of blood/plasma;</p> <p>j. negative feedback / less/no ADH secreted when blood solute concentration returns to normal;</p> |       | <b>7 max</b> |

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Notes | Total        |
|----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------|
| 9        | a | <p>a. (substitution mutation) caused by mutagen/errors in DNA replication/chemicals/radiation;</p> <p>b. occurs randomly when one nucleotide/base is replaced by another</p> <p><b>OR</b></p> <p>a single codon in a gene is altered;</p> <p>c. no consequences if (mutation) occurs to a non-coding portion of DNA /results in a same-sense or silent mutation /new codon codes for the same amino acid (degeneracy/redundancy);</p> <p>d. (consequences may occur if) one amino acid in the polypeptide is replaced by another;</p> <p>e. resulting in the protein/polypeptide being wrongly coded/not functioning/shortened/3 dimensional protein structure changed;</p> <p>f. mutations in germ cells or gametes may pass on to offspring</p> <p><b>OR</b></p> <p>mutations in somatic cells may lead to cancer;</p> <p>g. valid example;</p> |       | <b>4 max</b> |

| Question |                                                                    |                                                                                                                                                  | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Notes | Total   |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
|----------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------|---------|--|----|--------------------------------------|----------------------------------|---|----|-------------------|-----------------------|---|----|------------------|----------------------------------|---|----|---------------------|----------------------|---|----|--------------------------------------------------------------------|----------------------------------------------------------------|---|----|----------------------|--------------------|---|----|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---|----|-----------------------|-----------------------|---|--|----------|
| 9        | b                                                                  |                                                                                                                                                  | <table><thead><tr><th></th><th>Mitosis</th><th>Meiosis</th><th></th></tr></thead><tbody><tr><td>a.</td><td>maintains chromosome number/diploid;</td><td>halves chromosome number/haploid</td><td>;</td></tr><tr><td>b.</td><td>for growth/repair</td><td>for gamete production</td><td>;</td></tr><tr><td>c.</td><td>in somatic cells</td><td>in reproductive/sex/gamete cells</td><td>;</td></tr><tr><td>d.</td><td><u>one division</u></td><td><u>two divisions</u></td><td>;</td></tr><tr><td>e.</td><td>no exchange of genetic material between chromosomes/crossing over;</td><td>exchange of genetic material between chromosomes/crossing over</td><td>;</td></tr><tr><td>f.</td><td>results in two cells</td><td>results in 4 cells</td><td>;</td></tr><tr><td>g.</td><td>only divides chromatids/ chromatids separate during anaphase</td><td>also divides <u>homologous chromosomes/ homologous chromosomes</u> separate during anaphase 1 and (sister) chromatids separate during anaphase 2</td><td>;</td></tr><tr><td>h.</td><td>genetically identical</td><td>genetically different</td><td>;</td></tr></tbody></table> |       | Mitosis | Meiosis |  | a. | maintains chromosome number/diploid; | halves chromosome number/haploid | ; | b. | for growth/repair | for gamete production | ; | c. | in somatic cells | in reproductive/sex/gamete cells | ; | d. | <u>one division</u> | <u>two divisions</u> | ; | e. | no exchange of genetic material between chromosomes/crossing over; | exchange of genetic material between chromosomes/crossing over | ; | f. | results in two cells | results in 4 cells | ; | g. | only divides chromatids/ chromatids separate during anaphase | also divides <u>homologous chromosomes/ homologous chromosomes</u> separate during anaphase 1 and (sister) chromatids separate during anaphase 2 | ; | h. | genetically identical | genetically different | ; |  | 4<br>max |
|          | Mitosis                                                            | Meiosis                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| a.       | maintains chromosome number/diploid;                               | halves chromosome number/haploid                                                                                                                 | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| b.       | for growth/repair                                                  | for gamete production                                                                                                                            | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| c.       | in somatic cells                                                   | in reproductive/sex/gamete cells                                                                                                                 | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| d.       | <u>one division</u>                                                | <u>two divisions</u>                                                                                                                             | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| e.       | no exchange of genetic material between chromosomes/crossing over; | exchange of genetic material between chromosomes/crossing over                                                                                   | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| f.       | results in two cells                                               | results in 4 cells                                                                                                                               | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| g.       | only divides chromatids/ chromatids separate during anaphase       | also divides <u>homologous chromosomes/ homologous chromosomes</u> separate during anaphase 1 and (sister) chromatids separate during anaphase 2 | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |
| h.       | genetically identical                                              | genetically different                                                                                                                            | ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |         |         |  |    |                                      |                                  |   |    |                   |                       |   |    |                  |                                  |   |    |                     |                      |   |    |                                                                    |                                                                |   |    |                      |                    |   |    |                                                              |                                                                                                                                                  |   |    |                       |                       |   |  |          |

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Notes | Total    |
|----------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 9        | c | <p>a. <u>transcription factors</u> bind to DNA and can be activators or repressors<br/><b>OR</b><br/><u>transcription factors</u> promote or block transcription;</p> <p>b. protein/transcription factor/TF binds to <u>promoter</u> to activate transcription<br/><b>OR</b><br/><u>promoter</u> indicates where RNA polymerase binds to begin transcription;</p> <p>c. transcription factor/activator/protein binds to <u>enhancer</u> to increase the rate of transcription<br/><b>OR</b><br/>transcription factor/repressor/protein binds to <u>silencer</u> to decrease the rate of transcription;</p> <p>d. epigenetic tags can alter gene expression / methylation can alter gene expression;</p> <p>e. methylation of cytosine in the DNA of a promoter represses transcription;</p> <p>f. methylation of amino acids/protein in histones can cause transcription to be repressed or activated;</p> <p>g. thereby regulating the production of proteins from the gene<br/><b>OR</b><br/>proteins from gene expression display/create phenotypic traits;</p> <p>h. gene expression may be altered by (steroid) hormones/biochemicals that act as chemical signals to activate receptors that promote transcription;</p> <p>i. alteration of methyl tags on DNA in response to air pollution or in response to the environment;</p> <p>j. valid example of gene regulation;</p> |       | 7<br>max |

| Question |   | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Notes | Total    |
|----------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 10       | a | <p>a. organelles perform specialized functions that integrate/work together<br/><b>OR</b><br/>organelles are adapted to perform isolated tasks that coordinate;</p> <p>b. nucleus makes the messenger RNA which codes for the protein;</p> <p>c. ribosome reads the messenger RNA (mRNA) sequence / uses the mRNA to synthesize the protein / performs translation using mRNA;</p> <p>d. (ribosomes embedded) <u>rough</u> Endoplasmic Reticulum/<u>RER</u> synthesizes proteins for secretion out of the cell;</p> <p>e. RER transports proteins within the cell in vesicles/ forms vesicles around proteins for transport to golgi;</p> <p>f. Golgi apparatus where proteins are processed/modified/packaged for secretion;</p> <p>g. vesicles secrete proteins from the cell/fuse with membrane, release by exocytosis;</p> |       | 4<br>max |
| 10       | b | <p>a. the <u>external</u> intercostal muscles contract and the <u>internal</u> intercostal muscles relax;</p> <p>b. this causes the ribs to move upwards/outwards;</p> <p>c. diaphragm contracts / moves downwards/flattens;</p> <p>d. abdominal muscles relax;</p> <p>e. the chest cavity / thorax expands/ volume of thorax increases;</p> <p>f. reducing pressure in the thorax/chest cavity/lung (allowing air to enter);</p>                                                                                                                                                                                                                                                                                                                                                                                              |       | 4<br>max |

| Question |   |  | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Notes | Total    |
|----------|---|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 10       | c |  | a. adaptive immunity is the response to a specific antigen/pathogen;<br>b. macrophage/phagocyte/phagocytic white blood cell ingests/engulfs antigen and displays in/on plasma membrane;<br>c. helper T-cells bind to antigen / activated by antigens presented (on macrophage);<br>d. helper T-cells activate specific B-cells/B lymphocytes that can produce an effective antibody;<br>e. B-cells to divide by mitosis to make clones for more/large numbers plasma cells;<br>f. B-lymphocytes/plasma cells make antibodies /antibodies are specific to an antigen;<br>g. antibodies fight disease-causing organisms/viruses/bacteria (by lysis, agglutination,neutralization, tagging, other verified action.);<br>h. some plasma cells become (inactive) <u>memory cells</u> (that are retained in the body);<br>i. memory cells can be activated/quickly respond to produce antibodies in the case of reinfection; |       | 7<br>max |

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q32 | 1 marks

32.          C  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q31 | 1 marks

31.          D

|    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                  |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------|
| 9. | a | <p>a. <u>complementary base pairing</u> (between DNA nucleotides);</p> <p>b. adenine pairs with thymine and cytosine pairs with guanine;</p> <p>c. new strands with same/correct sequence/copy produced by <u>semiconservative replication</u></p> <p><b>OR</b></p> <p><u>semiconservative replication</u> is using a template strand (to make a new strand);</p> <p>d. DNA polymerase (III) adds <u>nucleotides</u> to the growing chain/to the template strand;</p> <p>e. <u>proofreading</u> is correction of errors/mutations (during DNA replication)</p> <p>f. <u>proofreading</u> by <u>DNA polymerase III</u></p> <p><b>OR</b></p> <p>error in replication/nucleotide with mismatched base detected by <u>DNA polymerase III</u></p> <p>g. <u>DNA polymerase III</u> has 3' to 5' exonuclease activity</p> <p><b>OR</b></p> <p><u>DNA polymerase III</u> reverses and excises nucleotide</p> <p><b>OR</b></p> <p>(mismatched) <u>nucleotide</u> removed and replaced (by DNA polymerase III);</p> |  | <b>4<br/>max</b> |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------|

| Question |    | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Notes                                                                                                                                                                              | Total            |
|----------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 9.       | b. | <p>a. pancreas cells monitor blood glucose concentrations;</p> <p>b. glucagon secreted by alpha cells <b>and</b> insulin by beta cells;</p> <p>c. glucagon/insulin/hormones secreted into/transported by bloodstream;</p> <p>d. insulin secreted when glucose concentration rises/is high;</p> <p>e. insulin stimulates uptake of glucose by liver/muscle/body cells;</p> <p>f. insulin stimulates conversion of glucose to glycogen (in liver/muscle cells);</p> <p>g. insulin stimulates body cells to use glucose instead of fat in cell respiration;</p> <p>h. glucagon secreted when glucose concentration falls/is low;</p> <p>i. glucagon stimulates breakdown of glycogen to glucose (by liver/muscle cells);</p> <p>j. negative feedback (is used to regulate blood glucose concentration);</p> |                                                                                                                                                                                    | <b>7<br/>max</b> |
| 9.       | c. | <p>a. isotonic is same water potential/solute potential/osmotic potential/solute concentration;</p> <p>b. (isotonic conditions) prevent (net) movement of water by <u>osmosis</u>;</p> <p>c. hypotonic plasma/tissue fluid causes water entry to blood/body cells;</p> <p>d. swelling/bursting of cells in (hypotonic plasma/tissue fluid);</p> <p>e. hypertonic plasma/tissue fluid causes water to exit cells;</p> <p>f. shrinkage/crenation/loss of volume/OWTTE;</p> <p>g. blood cells bathed in plasma;</p> <p>h. tissue fluid released by capillaries and then reabsorbed/flows between cells in tissues;</p>                                                                                                                                                                                      | <i>In mark point c and mark point e accept 'higher/less negative water potential' instead of hypotonic and accept 'lower/more negative water potential' instead of hypertonic.</i> | <b>4<br/>max</b> |

## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q30 | 1 marks

30.          C

APOLLO

# Natural selection

9 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q38 | 1 marks

38.          C  

Biology HL | Paper 1A | May 2025 TZ2 | Q38 | 1 marks

38.          A  

Biology HL | Paper 1A | May 2025 TZ3 | Q37 | 1 marks

37.          C  

Biology HL | Paper 1A | Nov 2025 TZ1 | Q38 | 1 marks

38.          C  

Biology HL | Paper 1A | Nov 2025 TZ3 | Q38 | 1 marks

38.          D

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                  |          |
|----|---|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------|
| 4. | a | i  | a. scale markers of the ruler are too far apart / OWTTE;<br>b. the mandible is too small to be precisely measured by a ruler / OWTTE;                                                                                                                                                                                                                                |                                                                                                                                  | 1<br>max |
| 4. | a | ii | a. Vernier/calliper/screw gauge (to measure directly on the beetle);<br>b. (measured) using microscope with (eyepiece) graticule;<br>c. beetle measured using app on mobile;<br>d. photograph taken (enlarged) and mandible measured (with ruler) / OWTTE;<br>e. digital software used to measure mandible;                                                          | b. Microscope alone is not sufficient.                                                                                           | 1<br>max |
| 4. | b |    | a. number/amount of flour beetles (at the start of each generation);<br>b. number/amount of predators/assassin bugs (at the start of each generation);<br>c. temperature;<br>d. humidity;<br>e. time;<br>f. food/nutrients/diet;<br>g. water;<br>h. space;<br>i. light;<br>j. variable relating to the organism (e.g. age, origin);<br>k. other reasonable variable; | Mark the first two answers only.<br><br>Do not accept mandible size.<br><br>"Environment/habitat" is too vague unless specified. | 2<br>max |

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| Question |   |  | Answers                                                                                                                                                                                                                                                                                                                                                                                                         | Notes | Total |
|----------|---|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 4.       | c |  | a. general trend is decreasing size/negative correlation;<br>b. from generation 1 to 3/4 mandible size is constant/fluctuates;<br>c. after generation 3/4 predation (starts) decreasing mandible size<br><b>OR</b><br>lowest size in generation 6<br><b>OR</b><br>steepest decrease between 5 and 6;<br>d. towards the end of the experiment/generation 6 and 7, predation has (small/slight) increase / OWTTE; |       | 2 max |

| Question |   |  | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Notes                                                                                                                                                                                       | Total |
|----------|---|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 4.       | d |  | a. variation of mandible size within the population;<br>b. predation causes selection pressure<br><b>OR</b><br>as mandible size increases so does the likelihood of predation<br><b>OR</b><br>beetles with smaller mandibles have higher escape/survival rates<br><b>OR</b><br>smaller mandible is a competitive advantage / OWTTE;<br>c. beetles with smaller mandibles have more chances of reproducing;<br>d. overproduction of offspring with small mandible;<br>e. competition for resources leads to survival of the fittest / small mandible beetles;<br>f. <u>allele</u> for small mandible is inherited/passed on to offspring;<br>g. increasing the <u>frequency</u> of allele/phenotype/beetles with smaller mandibles (in the population); | <i>c. Must include idea of reproduction.</i><br><br><i>e. Do not accept "survival of the fittest" out of context/as a sole answer.</i><br><br><i>f. Do not accept "gene" or "genotype".</i> | 4 max |

|     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                         |          |
|-----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 10. | a | <p><i>Structure</i></p> <p>a. RNA is single-stranded;</p> <p>b. polymer/chain of (RNA) nucleotides;</p> <p>c. (ribonucleotides) contain <u>ribose</u> and phosphate and base/named bases;</p> <p>d. sugar phosphate bonds / phosphodiester bonds (between sugar/ribose and phosphate)</p> <p><b>OR</b></p> <p>backbone made of alternating phosphate and ribose/sugar;</p> <p><i>Evidence</i></p> <p>e. (RNA) can be replicated;</p> <p>f. (RNA) has some catalytic activity (so it may have acted initially as both the genetic material and the enzymes of the earliest cells);</p> <p>g. ribozymes/rRNA in the ribosome (are still used to) catalyse peptide bond formation / involved in protein synthesis</p> <p><b>OR</b></p> <p>ribosomes contain rRNA/ribozymes with catalytic/enzymatic function</p> <p>h. some viruses contain RNA (supports the idea that RNA could have been used before genes made of DNA evolved);</p> | <p><i>Allow a labelled drawing for the structure marking points (base must be attached to C1 and phosphate to C5).</i></p> <p><i>For c. do not allow "sugar" instead or ribose.</i></p> | 5<br>max |
|-----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Notes | Total    |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 10. b    | <p>a. DNA can be amplified (for analysis) by PCR;</p> <p>b. to select endangered/evolutionary distinct species for conservation/EDGE of Existence programme;</p> <p>c. use of barcodes/environmental DNA allows to investigate/monitor biodiversity of habitats rapidly / to identify species;</p> <p>d. genetic profiling of species for identification;</p> <p>e. example of identification purpose / importance of identification: tracking populations / rewilding of native species / captive breeding / detecting invasive species / combating illegal wildlife trade/poaching / assess richness of a habitat / identify new species / track endangered species / cloning;</p> <p>f. seed / tissue banks for long term storage of living material / maintain viability of seeds for long periods / propagation in the future / reintroducing species / preserve genetic material of endangered species / study effects of climate change;</p> |       | 3<br>max |



## Mark-scheme answers

Biology HL | Paper 1A | Specimen 2025 | Q39 | 1 marks

39.        A

Biology HL | Paper 1A | Specimen 2025 | Q40 | 1 marks

40.        C

APOLLO

# Stability and change

2 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q39 | 1 marks

39.          D  

Biology HL | Paper 1A | May 2025 TZ3 | Q39 | 1 marks

39.          B

APOLLO

# Climate change

5 questions

## Mark-scheme answers

Biology HL | Paper 1A | May 2025 TZ1 | Q40 | 1 marks

40.          A  

Biology HL | Paper 1A | May 2025 TZ2 | Q40 | 1 marks

40.          D  

Biology HL | Paper 1A | May 2025 TZ3 | Q8 | 1 marks

8.          D

|    |   |    |                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |       |
|----|---|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2. | a | i  | a. sweating/sweat secretion;<br>b. vasodilation / skin arterioles widen / increased blood flow to skin;<br>c. shunt vessels in the skin close;                                                                                                                                                                                                              | <i>b. Do not accept 'blood vessels widen' unless the answer indicates that more blood will flow to the skin.</i>                                                                                                                                                                                                                                                                                                                                   | 1 max |
| 2. | a | ii | a. negative (feedback) because temperature/body heat is reduced (followed the increase);<br>b. negative (feedback) because body temperature returns (to normal/to the original level);<br>c. negative (feedback) because sweating/response stops (after enough cooling);<br>d. negative (feedback) because every change is followed by the opposite change; |                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1 max |
| 2. | b |    | a. CO <sub>2</sub> is released/is a greenhouse gas;<br>b. long wave radiation/heat/infrared (emitted by the Earth) trapped/absorbed by CO <sub>2</sub> ;<br>c. (so) heat retained in atmosphere;                                                                                                                                                            | <i>Do not award a mark for 'Earth's temperature is increased' as this is in the question.</i><br><br><i>b. Do not accept 'reflected back' instead of trapped or absorbed and do not accept absorption of any type of radiation from the sun.</i><br><br><i>The word 'heat' can be used for both marking points b. and c. but in b. the idea is heat retained by CO<sub>2</sub> the whereas the idea in c. is heat retention in the atmosphere.</i> | 2 max |
| 2. | c |    | a. positive feedback because warming causes melting of polar ice;<br>b. positive feedback because less ice means less sunlight is reflected (lower albedo);<br>c. positive feedback because more heat is absorbed by the Earth's surface which becomes warmer;                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1 max |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Biology HL | Paper 1A | Nov 2025 TZ1 | Q40 | 1 marks

40.      A