



Mark Scheme (Results)

Summer 2025

Pearson Edexcel International Advanced
Subsidiary Level In Biology (WBI12)
Paper 01 Cells, Development, Biodiversity,
and Conservation

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---------------------|------|
| 1(a) | (a group of) organs that work together to perform {one function / more than one function / named function} | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|-----------------|---|------|
| 1(b)(i) | Golgi apparatus | ACCEPT Golgi body / Golgi / Golgi complex IGNORE vesicles ACCEPT phonetic spellings | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------|
| 1(b)(ii) | <p>A description that includes two of the following points:</p> <ul style="list-style-type: none"> • {(rER) vesicles fuse with / protein enters} Golgi (1) • {protein / enzyme} modified (1) • {protein / enzyme} is packaged into (secretory) vesicles (by Golgi) (1) | <p>ACCEPT descriptions of correct modifications IGNORE process</p> <p>IGNORE lipids ACCEPT description of how it is packaged e.g. bud off from cisternae</p> <p>rER can access either LHS OR this ecf applies from (i) for rER ONLY</p> <ul style="list-style-type: none"> • translation / synthesis of primary structure / polypeptide synthesis / protein synthesis / formation of {secondary / tertiary} structure / folded into 3D shape (1) • packaging of {enzyme / protein} into (transport) vesicle (to be transported to Golgi apparatus) (1) | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| 1(b)(iii) | <ul style="list-style-type: none">• correct width measurement conversion (1)• correct magnification to two significant figures (1) | <p><u>Example of calculation:</u></p> <p>$3.2 \times 10\,000 = 32\,000\ \mu\text{m}$ or 0.95 correctly converted</p> <p>$(32\,000 \div 0.95) = (\times)34\,000 / 3.4 \times 10^4$</p> <p>ACCEPT correct answers in standard form</p> <p>ecf for incorrect conversion</p> <p>Correct answer with no working shown scores full marks</p> | (2) |

| Question Number | Answer | Mark |
|-----------------|--|------|
| 2(a) | <p>The only correct answer is A: 1. (Archaea) and 2. (Bacteria) only</p> <p><i>B is not correct because the Bacteria domain contains prokaryotic organisms</i></p> <p><i>C is not correct because the Eukarya domain does not contain prokaryotic organisms</i></p> <p><i>D is not correct because the Eukarya domain does not contain prokaryotic organisms</i></p> | (1) |

| Question Number | Answer | Mark |
|-----------------|--|------|
| 2(b)(i) | <p>The only correct answer is D: cell membrane, controls what enters and leaves the cell</p> <p><i>A is not correct because Z is the cell membrane</i></p> <p><i>B is not correct because Z is the cell membrane</i></p> <p><i>C is not correct because the cell membrane controls what enters and leaves the cell</i></p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------|
| 2(b)(ii) | <p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • (X is) {flagellum / flagella} and it is involved in movement (of the cell) (1) • (Y is) {pilus / pili} and it is involved in adhesion (to surfaces / cells) (1) | <p>REJECT in context of sperm IGNORE tail</p> <p>ACCEPT other correct functions e.g. enables (horizontal) transfer of (genetic) information / conjugation / connecting cells IGNORE reproduction / cell communication</p> | (2) |

| Question Number | Answer | Mark |
|-----------------|---|------|
| 2(b)(iii) | <p>The only correct answer is D: ribosome</p> <p><i>A is not correct because prokaryotic cells do not contain chloroplasts</i></p> <p><i>B is not correct because prokaryotic cells do not contain linear DNA</i></p> <p><i>C is not correct because prokaryotic cells do not contain a nucleolus</i></p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| 2(c)(i) | <ul style="list-style-type: none"> (resolution is a measure of the microscope's) ability to distinguish between two points which are close together (on an object) (1) | ACCEPT the smallest distance between 2 objects that allows them to view them as 2 separate objects ACCEPT how far apart two points need to be to be seen as separate structures | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 2(c)(ii) | <ul style="list-style-type: none"> correct calculation (1) correct answer to two decimal places (1) | <u>Example of calculation:</u> $\left \frac{4}{3} \times \pi \times (0.3)^3 \right \text{ or } 0.1131 \mu\text{m}^3$ =0.11 (μm^3) ACCEPT correct standard form to 2 decimal places no ecf Correct answer with no working shown scores full marks | (2) |

| Question Number | Answer | Mark |
|-----------------|---|------|
| 3(a) | <p>The only correct answer is B one male nucleus is needed to fertilise an egg cell nucleus to form the embryo</p> <p><i>A is not correct because a male nucleus formed from the generative nucleus is not involved with pollen tube formation</i></p> <p><i>C is not correct because the male nuclei are not diploid</i></p> <p><i>D is not correct because one male nucleus fertilises two polar nuclei</i></p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|------------------------|---|------|
| 3(b)(i) | prophase {1 / 1 / one} | do not accept prophase unqualified do not accept prophase {11 / 2} IGNORE meiosis | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------|
| 3(b)(ii) | <p>A description that makes reference to two of the following:</p> <ul style="list-style-type: none"> • {independent / random} assortment of (maternal and paternal) chromosomes (in metaphase I/II) (1) • random {fusion / fertilisation} (of genetically different gametes) (1) • correct epigenetic modification (1) | <p>ACCEPT {chromatids / alleles} for chromosomes IGNORE genes</p> <p>ACCEPT segregation for assortment IGNORE DNA REJECT incorrect phase of meiosis</p> <p>ACCEPT pollination with pollen from a different {plant / species} IGNORE random mating</p> | (2) |
| Question Number | Answer | Additional guidance | Mark |
| 3(b)(iii) | <p>Number of heterozygotes ÷ number of individuals in the population</p> | <p>determine the number of heterozygotes and divide it by the number (of individuals) in the passionflower population</p> <p>IGNORE species</p> <p>IGNORE number of {individuals / organisms} unqualified do not credit equations with ×100</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 3(c) | An explanation that makes reference to the following: <ul style="list-style-type: none">• (selection of seeds) from many different {plants / areas / varieties} to ensure {different alleles / genetic diversity} (1) • (seeds are) x-rayed to check for {viability / presence of (alive) embryo} (and only viable seeds selected) (1) | ACCEPT biodiversity for genetic diversity | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|----------|--------------------------------|------|
| 4(a)(i) | 1.96(:1) | ACCEPT 2:1 ignore fractions | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------|
| 4(a)(ii) | as (the plant) age increases the (percentage of) cellulose decreases and (the content of) lignin increases | ACCEPT other correct conclusions e.g. as time increases the difference in the mean percentage between cellulose and lignin decreases e.g. as the age increases the percentages of cellulose and lignin become more similar e.g. as the age of the bamboo plants increases, the ratio of cellulose to lignin decreases e.g. as they age, cellulose always higher than lignin | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| 4(a)(iii) | <p>An explanation that includes three of the following points:</p> <ul style="list-style-type: none"> • hydrogen bonds between (adjacent) {cellulose molecules / microfibrils} (1) • (microfibrils) arranged in {layers / sheets} at different angles (1) • {cellulose / microfibrils} embedded in {pectin / hemicellulose} (1) • lignin in secondary {cell wall / thickening} (of xylem) (1) | <p>ACCEPT (cellulose molecules / microfibrils) arranged in {criss-cross pattern / a mesh / matrix / different directions / layers}</p> <p>ACCEPT microfibrils arranged at different angles</p> <p>ACCEPT {cellulose / microfibrils} held together by pectin</p> <p>IGNORE calcium pectate holds cell walls together</p> <p>ACCEPT description of lignin {spiral / rings / helices} etc</p> | (3) |

| Question Number | Answer | Mark |
|-----------------|---|------|
| 4(b) | <p>The only correct answer is C plasmodesmata</p> <p><i>A is not correct because it is a plasmodesmata</i></p> <p><i>B is not correct because it is a plasmodesmata</i></p> <p><i>D is not correct because it is a plasmodesmata</i></p> | (1) |
| Question Number | Answer | Mark |
| 4(c)(i) | <p>The only correct answer is B 1, 3 and 4 only</p> <p><i>A is not correct because xylem transport water molecules to the leaves</i></p> <p><i>C is not correct because xylem transport water molecules to the leaves</i></p> <p><i>D is not correct because xylem transport inorganic ions to the leaves</i></p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 4(c)(ii) | <p>An answer that includes the following point:</p> <ul style="list-style-type: none">• xylem and phloem are arranged in a circular pattern in a stem whereas they are arranged in a {horizontal / straight line} in the leaf (1) | <p>ACCEPT correct labelled diagram</p> <p>ACCEPT xylem closer to upper surface in leaf whereas xylem is closer to the centre of the stem / converse for phloem</p> <p>ACCEPT xylem and phloem in stem are separated by cambium</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| 5(a) | An explanation that makes reference to the following points: <ul style="list-style-type: none">• because {more sugar cane can be grown / there is always more waste from commercial sugar production} (1)• drinking cups made from plant-based products {can decompose / can be broken down by microorganisms / are biodegradable} (1) | IGNORE answer without reference to the given context ACCEPT it is carbon neutral IGNORE no pollution / can be recycled / can be reused | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 5(b) | <p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> • there is a decrease in the bacterial {population / number} in the tubes with {olive oil / extract} (1) • high concentration of extract {is more effective (antimicrobial concentration) / has more antimicrobial properties} (1) • there is a significant {difference / change} between the mean number of living bacteria {at 0.5 / after 0.0 hours / correct stated time} as the {error / SD} bars do not overlap (1) • relevant comment about methodology (1) | <p>IGNORE it kills more bacteria /decreases most do not allow converse</p> <p>IGNORE comments about there is a significant {difference / change} as the {error / SD} bars do not overlap without reference to a correct time IGNORE size of {error / SD} bars</p> <p>e.g. lack of information about controlled variables e.g. temperature, type of bacteria / number of repeats / no indication of what high or low concentrations were / unequal time intervals IGNORE no evidence of repetition / no repeats / sample size / control used</p> | (4) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---------------------|------|
| 5(c)(i) | The number of cells increased as the time in interphase decreased | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---------------------|------|
| 5(c)(ii) | The only correct answer is D <i>A is not correct because an increase from 2×10^6 to 16×10^6 is 700%</i> <i>B is not correct because an increase from 2×10^6 to 16×10^6 is 700%</i> <i>D is not correct because an increase from 2×10^6 to 16×10^6 is 700%</i> | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------|
| 5(c)(iii) | <p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none">• increase in rate of {mitosis / cell division} / cells proceed to {prophase / mitosis} quicker (1)• (due to) faster {DNA / organelle} replication (1)• (resulting in an) increase in the mitotic index (1) | <p>ACCEPT as the concentration of PHA increases the number of cells increases} ACCEPT less time in {interphase / G1/ S / G2} / shorter cell cycle REJECT more time in interphase linked to increased rate of mitosis</p> <p>ACCEPT the mitotic index increases because the number of cells in mitosis is increasing compared to the number of cells in interphase / correct equation for mitotic index</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------|
| 6(a)(i) | <p>An answer that makes reference to two of the following:</p> <ul style="list-style-type: none"> • reference to damage stimulating chemical responses that lead to the modification of {DNA / histones} (1) • detail of the modification (1) • (therefore) DNA is less tightly wrapped around histones / euchromatin formed (1) • (therefore) {RNA polymerase / transcription factor} can bind (to promoter region) (1) | <p>ACCEPT production of transcription factors / hormone production / DNA methylation / DNA demethylation / epigenetic modification / histone modification / histone acetylation / demethylation of repressor gene / differential gene expression IGNORE damage causes gene {expression / to be switched on} IGNORE DNA acetylation</p> <p>e.g. {acetyl / methyl / phosphate} group added to {histone / lysine} e.g. methyl group {added to / removed from} {DNA / cytosine / CpG site} REJECT methyl added to cysteine</p> <p>ACCEPT promoter region now accessible</p> <p>IGNORE transcription / translation</p> | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| 6(a)(ii) | <p>An answer that makes reference to the following:</p> <ul style="list-style-type: none">• totipotent (stem cell) can differentiate into {all / more} types of cell including {extra-embryonic / placental} cells / converse (1) | <p>IGNORE develop / give rise to ACCEPT specialise for differentiate</p> <p>ACCEPT totipotent (stem cell) can differentiate into {all / more} types of cell ACCEPT totipotent (stem cell) can differentiate into {extra-embryonic / placental} (cells) ACCEPT converse</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------------|
| 6(b) | <p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> • post-transcriptional {modification/change} (to pre-mRNA) (1) • (all) introns are removed by {enzymes / spliceosomes} (1) • (some) exons removed (to form each strand) (1) • some strands have had more exons removed / strand 1 contains {fewer / 9} exons / strands 2 and 3 contain {more / 10} exons (1) • all three mRNA strands have {1 / 4 / 5 / 6 / 8 / 9 / 10} (exons) (1) | <p>ACCEPT alternative splicing</p> <p>ACCEPT introns are spliced</p> <p>IGNORE exons are rearranged ACCEPT active mRNA has few exons than pre-mRNA</p> <p>ACCEPT correct description of any exon removal differences ACCEPT different strands have different combinations of exons ACCEPT strand 1 has fewer mRNA {nucleotides / bases} than strands 2 and 3</p> <p>ACCEPT all do not have {7 / 13} (exons)</p> | (4) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------|
| 6(c) | <p>An answer that includes the following points:</p> <ul style="list-style-type: none"> • (stem cells) can {differentiate / specialise} into different {cells / tissues / organs} (1) • great {potential / importance / medical implications} of the research in developing medical therapies (1) • starfish do not have a {fully developed nervous system / brain} (1) | <p>IGNORE differentiation unqualified / give rise to ACCEPT {differentiate / specialise} into examples of named {cells / tissues / organs}</p> <p>IGNORE used in research unqualified ACCEPT suitable {named / examples of} research ACCEPT named example of a medical therapy use of stem cells in humans e.g. {repair / transplant} {cells / tissues / organs} in humans ACCEPT used to treat certain diseases e.g. cancer / heart disease IGNORE disease unqualified</p> <p>ACCEPT starfish may not feel pain / starfish are not an endangered species / not {harmed / killed} by process / no need to use (human) {embryos / embryonic stem cells} / fewer ethical issues</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------|
| 7(a)(i) | <p>An answer that makes reference to two of the following:</p> <ul style="list-style-type: none"> (water) for {hydrolysis (reactions) / photosynthesis} (1) {solvent for / transport of} named {molecules / substances} (1) maintain turgidity of {vacuole / cells} | <p>IGNORE references to osmotic effects</p> <p>ACCEPT (used for) {metabolic / catabolic} reactions</p> <p>ACCEPT activation of enzymes</p> <p>e.g. inorganic ions / sucrose / assimilates / (in)organic solutes / plant hormones</p> <p>IGNORE nutrients</p> <p>ACCEPT provides support to plant</p> | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------|
| 7(a)(ii) | <p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> nitrate for the conversion of glucose / formation of {amino acids / proteins / enzymes / nucleotides / chlorophyll} (1) calcium ions are needed to form calcium pectate (1) calcium pectate is needed to {form the middle lamella / hold cells more firmly together / increase strength of cell wall / holds microfibrils together} (1) | <p>ACCEPT correct named protein</p> <p>IGNORE pectate</p> <p>ACCEPT {protein / enzymes / nucleotides / chlorophyll} needed to enable {cell division / DNA replication / photosynthesis / growth}</p> | (3) |

| Question Number | Answer | Mark |
|-----------------|---|------|
| 7(b) | <p>The only correct answer is C 2 183 071 550 kg</p> <p><i>A is not correct because that was produced by continent P</i></p> <p><i>B is not correct because 2 183 071 550 kg were produced by continent S</i></p> <p><i>D is not correct because that was produced by continent T</i></p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------|
| 7(c)(i) | <ul style="list-style-type: none"> • correct substitution (1) • correct answer $\times 100$ to two decimal places (1) | <p>Example of calculation:</p> $\frac{0.58-0.65}{\frac{0.58+0.65}{2}} = 0.1138211$ <p>=(-)11.38 (%)</p> <p>Correct answer with no working shown scores full marks only ecf = correct answer for gluten for A and B given to 2 decimal places</p> | (2) |

| Question Number | Answer |
|-------------------|--|
| *7 (c)(ii) | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> • increase in {yield / growth} with {added magnesium (ions) / B / C} / converse • there is (a greater) increase in {gluten content / mass of wheat grains} with {added magnesium (ions) / B / C} / converse • there is (a greater) increase in {gluten content / mass of wheat grains} with {C / magnesium added to nutrient solution} than {added to leaves / B} / converse • magnesium ions activate enzymes for {inorganic ion uptake / protein synthesis / photosynthesis / respiration / metabolic reactions} • magnesium (ions) bind to {allosteric / binding} site / change the shape of the enzyme {active / binding} site / more likely for ES complexes to form / converse • magnesium (ions) needed to form {chlorophyll / chloroplasts} / converse • {glucose production / chemical energy store} due to photosynthesis • more glucose results in {more protein synthesis / more growth / greater mass} • {glucose / chemical energy store} can be used in respiration to provide ATP • ATP needed for {mitosis / protein synthesis / other named processes} • greater inorganic ion uptake via active transport • more calcium pectate formed / calcium pectate for middle lamella • increased nitrate uptake results in more {glucose converted into amino acids / protein synthesis / proteins / named proteins e.g. chlorophyll / enzymes} • higher yield means farmers have more to sell • higher {gluten content / higher protein content / mass of wheat grains} increases the money that the farmer will earn} • consideration of cost of buying fertiliser • consideration of cost of treatment application • consideration of other aspects that could reduce price of flour e.g disease / drought / type of wheat grown • suitable consideration of methodology aspects • suitable consideration of statistical data e.g. repeats, no way to determine if there is a significant difference between the groups |

| | | |
|---------|-----|---|
| | | (6) |
| Level 0 | 0 | No awardable content |
| Level 1 | 1-2 | Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. |
| Level 2 | 3-4 | Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts / concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure. |
| Level 3 | 5-6 | Demonstrates comprehensive knowledge and understanding by selecting and applying relevant biological facts / concepts. Consequences are discussed which supported throughout by sustained linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------------|
| 8(a) | A description that makes reference to three of the following: <ul style="list-style-type: none">• acrosome fuses with sperm cell membrane (1)• {digestive enzymes / hydrolytic enzyme / acrosin} released (1)• which {digest / breakdown} (molecules in) the zona pellucida (1)• sperm cell membrane fuses with egg cell membrane | IGNORE binds to ZP3 IGNORE membrane / ZP3 ACCEPT binds to sperm receptor IGNORE binds to ZP3 IGNORE nucleus membrane fusing | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 8(b)(i) | <p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> • {ZP3 / egg-binding protein / sperm receptor} may {be missing / not be complementary shape to what it should bind to / changed shape / not be functional} (1) • the sperm cell {might not have digested through (all) the zona pellucida / may not be able to get through zona pellucida to reach sperm receptor on egg cell membrane} (1) • suitable reasons as to why there may be differences in ZP3 / egg-binding protein / receptor (1) | <p>ACCEPT some sperm cells do not reach egg cell / low acrosin concentration / no acrosome reaction ACCEPT receptor already occupied ACCEPT changes in receptor shape after {fertilisation / cortical reaction} IGNORE active sites</p> <p>ACCEPT zona pellucida has hardened ACCEPT zona pellucida was too thick IGNORE fertilisation membranes</p> <p>e.g. mutations, epigenetic modification of protein gene</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------|
| 8(b)(ii) | <p>An explanation that makes reference to two of the following:</p> <ul style="list-style-type: none"> cortical granules fuse with (egg) cell membrane and releases {chemicals / enzymes} (1) hardens the zona pellucida (1) preventing other sperm from binding to sperm receptors (1) | <p>IGNORE hardens the membrane</p> <p>ACCEPT prevents other sperm binding to ZP3</p> <p>IGNORE prevents more sperm entering the egg cell / prevents polyspermy</p> | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------|
| 8(c)(i) | <p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> {comparison / analysis} of the sequences in named biological molecules / molecular phylogeny (1) {more similarities / fewer differences} between molecules means <i>E. viridis</i> and <i>E. lucunter</i> are more closely related (1) | <p>e.g. DNA sequence, mRNA sequence, protein sequence, allele sequence, base sequence / intron sequence</p> <p>IGNORE bases unqualified / gene / genome / genotype}</p> <p>ACCEPT comparison of banding pattern in gel electrophoresis</p> <p>IGNORE phenotypic comparisons</p> | (2) |

| Question Number | Answer |
|-----------------|--|
| *8(c)(ii) | <p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> • geographical isolation / allopatric speciation • examples of reproductive isolation e.g. different times of breeding / different mating behaviour / sperm cell cannot fertilise egg cell / no gene flow / incompatible reproductive organs / offspring may be infertile / adaptive radiation • comparison of distribution of the species of reef urchin involving {named species / named locations / oceans} • <i>E. vanbrunti</i> populations do not (usually) meet {<i>E. lucunter</i> / <i>E. viridis</i>} and therefore do not reproduce • sympatric speciation between <i>E. lucunter</i> and <i>E. viridis</i> • consideration of genetic variation / differences in alleles / different alleles due to mutations / changes in gene pool • consideration of different alleles in ancestor species of reef urchin • consideration of different selection pressures in different locations • some alleles may confer an advantage, those reef urchin survived and reproduced and passed on alleles to offspring • natural selection resulted in speciation / natural selection occurred • resulting in different alleles increasing in frequency in the different populations / accumulation of different genetic information in the different populations // loss of alleles from population • formation of <i>E. vanbrunti</i> species occurred first / converse for other two species • <i>E. lucunter</i> and <i>E. viridis</i> {have more recent common ancestor / more closely related} / converse for <i>E. vanbrunti</i> • reproductive isolation due to non-complementary shaped proteins and receptors • one allele that is different controls the shape of {ZP3-binding molecule / ZP3 / egg-binding protein / sperm receptor} • {<i>E. vanbrunti</i> / <i>E. viridis</i>} ZP3-binding molecule is not complementary to the shape of the <i>E. lucunter</i> ZP3 (receptor) so the acrosome reaction doesn't occur • {<i>E. vanbrunti</i> / <i>E. viridis</i>} egg-binding protein is not complementary to the shape of the <i>E. lucunter</i> sperm receptor so {the sperm nucleus cannot enter the egg cell / fertilisation does not occur} <p style="text-align: right;">(6)</p> |

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|---------|-----|---|--|
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| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | <p>An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information.</p> <p>The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.</p> | |
| Level 2 | 3-4 | <p>An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.</p> <p>The explanation shows some linkages and lines of scientific reasoning, with some structure.</p> | |
| Level 3 | 5-6 | <p>An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.</p> <p>The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.</p> | |

