

Mark Scheme (Results)

June 2022

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

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General Marking Guidance

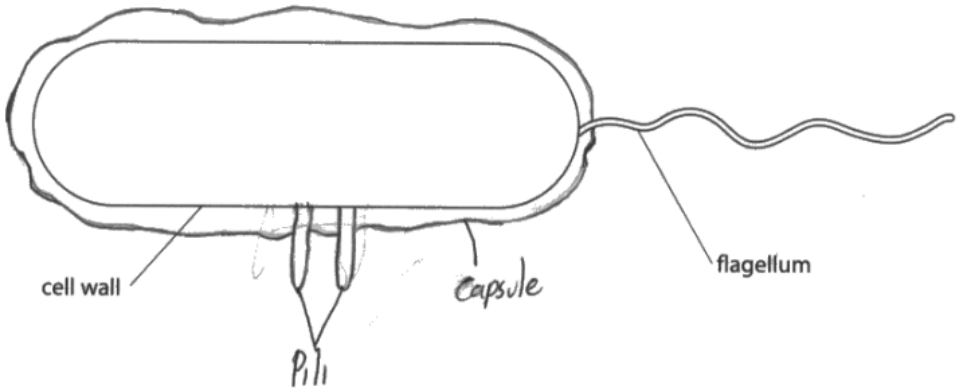
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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)	An answer that makes reference to the following point: • group of organs that work together to perform {one / one or more / specific} functions		**(1)**

Question Number	Answer	Additional guidance	Mark
1(b)(i)	An answer that makes reference to the following point: • group of (similar) cells working together to perform a (specific) function		**(1)**

Question Number	Answer	Mark
1(b)(ii)		**(4)**

Structure	Propels male gamete towards female gamete	Modified by the action of cortical granules	Produce ATP by respiration	Contain linear DNA
flagellum	☒ A			
mitochondria			☒ C	
nucleus				☒ D
zona pellucida		☒ B		

Question Number	Answer	Additional guidance	Mark
2(a)	An answer that includes the following points: • capsule correctly drawn and labelled (1) • (at least) two pili correctly drawn and labelled (1)	<u>Example of diagram</u>  	**(2)**

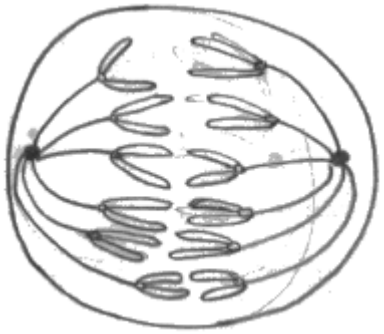
Question Number	Answer	Additional guidance	Mark
2(b)	An answer that makes reference to four of the following points: • increasing sodium chloride concentrations (above 10 g dm^3) decreases the growth rate (of both bacteria) (1) • (salt concentration between 0-6 g dm^3 caused) an initial {increase / constant} rate (1) • more rapid decrease in *L. piscium* growth rate (1) • *B. thermosphacta* had a larger growth rate (than *L. piscium* at all sodium chloride concentrations) (1) • *B. thermosphacta* was able to continue growing in sodium chloride concentrations above {22-25} g dm^3 whereas *L. piscium* had no growth / *L. piscium* stopped growing at a concentration {38-46} g dm^3 below the concentration that *B. thermosphacta* stopped growing (1) • data is more scattered about the line of best fit for *B. thermosphacta* (than *L. piscium*)	ACCEPT negative correlation (between sodium chloride concentration and growth rate) ACCEPT converse ACCEPT converse Accept *B. thermosphacta* is more {tolerant / resistant} (than *L. piscium*) of higher sodium chloride concentrations Accept *B. thermosphacta* stopped growing at {62-70} g dm^3 whereas *L. piscium* stopped growing at {22-24} g dm^3 ACCEPT converse	**(4)**

Question Number	Answer	Additional guidance	Mark
3(a)(i)	A calculation in which: • calculation of volume of sphere (1) • calculation of volume of hemisphere to nearest whole number (1)	<u>Example of calculation:</u> answer between 65416.67 to 65476.19 whole number answer between 32708 to 32738 Correct answer scores full marks	**(2)**

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	An explanation that makes reference to two of the following: • (because) calabash fruits are renewable / more can be grown / will not run out / available to future generations (1) • biodegradable / can be broken down by decomposers (1) • carbon neutral (1)	 ignore produces less greenhouse gases	**(2)**

Question Number	Answer	Mark
3(b)(i)	The only correct answer is B one *A is not correct because they provide support to the plant* *B is not correct because they are not involved in transporting substances* *C is not correct because they are not involved in transporting substances*	**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	An answer that makes reference to four of the following: Similarities: • both (fibres) contain cellulose (in the cell wall) (1) • both have tubular structures (1) • both do not contain a nucleus (1) Differences (max 3): • phloem (sieve tubes) have {sieve plates / (perforated) end walls} whereas xylem (vessels) have no {end walls / sieve plates} (1) • phloem (sieve tubes) {contain cytoplasm / are not hollow} whereas xylem (vessels) {do not contain cytoplasm / are hollow} (1) • phloem (sieve tubes) contain no {lignin / secondary thickening} whereas xylem contain {lignin / secondary thickening} (1) • phloem have plasmodesmata whereas xylem have pits (1)	ACCEPT piecing together from adjacent sentences ACCEPT both have a cell wall ignore organelles ACCEPT phloem (sieve tubes) contain living cells whereas xylem (vessels) contain dead cells ACCEPT phloem cell walls are thinner than xylem cell walls / converse ACCEPT xylem have pits whereas phloem do not / phloem have plasmodesmata whereas xylem do not	**(4)**

Question Number	Answer	Additional guidance	Mark
4(a)(i)	An answer that makes reference to the following points: • centrioles and spindle fibres shown (1) • 6 chromosomes being pulled to each pole (1)	Example of diagram: 	**(2)**

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	A calculation in which: • calculation of number of degrees per minute (1) • calculation of number of degrees (including unit) (1)	<u>Example of calculation:</u> 270 ÷ (9 × 60) = 0.5° 0.5 × 20 = 10° Correct answer scores full marks	**(2)**

Question Number	Answer	Additional guidance	Mark
4(b)(i)	• location of gene(s) on a(n Indian muntjac) chromosome	ACCEPT {nucleotide base pairs / allele} for gene ACCEPT chromatid for chromosome	**(1)**

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation that makes reference to the following points: • (egg cells are) haploid (1) • (egg cell chromosomes) have {an altered base sequence / different alleles} (than body cell chromosomes) (1) • due to {(random) mutations (during DNA replication) / crossing over / random assortment / independent assortment} (1)	ACCEPT contain {3 / half the number of} chromosomes do not accept genes ACCEPT chromosomes mutations due to errors in separation of {chromatids / chromosomes}	**(3)**

Question Number	Answer	Additional guidance	Mark
4(c)	An answer that makes reference to two of the following points: • (because the parents are) different species (1) • (because {maternal and paternal / 3 and 23}) chromosomes would not pair up (1) • (therefore) cannot make {haploid / sperm / egg} cells (1)	ACCEPT because diploid number (of either species) could not be restored ignore parents have different number of chromosome pairs ACCEPT meiosis cannot occur	**(2)**

Question Number	Answer	Mark
5(a)(i)	The only correct answer is B endemic *A is not correct because the correct term is endemic* *C is not correct because the correct term is endemic* *D is not correct because the correct term is endemic*	**(1)**

Question Number	Answer	Additional guidance	Mark
5(a)(ii)	A calculation in which: • correct difference (1) • correct percentage change (1)	<u>Example of calculation:</u> 950-7100 = (-)6150 (-6150 ÷7100) x 100 = (-)87(%) Correct answer scores full marks	**(2)**

Question Number	Answer
***5(b)**	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. 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. • common ancestor {lived on Hawaii islands / had shorter beak than Amakihi / less powerful beak than Palila} • colonisation of new island / geographical isolation • change in the environment / competition for food / (new) selection pressures • genetic variation in population / mutation resulted in new allele(s) • some alleles conferred an advantage therefore bird more likely to survive and reproduce than other birds and pass on those advantageous alleles to next generation • repeated over many generations leading to new species • idea of reproductive isolation Amakihi • Amakihi has a longer beak • (therefore) was able to drink (more) nectar from flowers / tree sap / access more spiders / insects • Amakihi has larger population due to being adapted to live in more habitats / idea that it can access more types of food sources Palila • Palila has a {more powerful beak / beak which could crack open the coat (of seed)} • Palila was able to eat (more) seeds / berries **(6)**

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	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. The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.	evolution of generic new species explained with basic information 1 mark – very limited explanation of evolution of a (generic) new species 2 marks – more detailed explanation of evolution of a (generic) new species OR one point about generic explanation plus a basic linkage to either Amakihi or Palila
Level 2	3-4	An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning, with some structure.	Level 1 plus some linkages to either Amakihi or Palila 3 marks = basic linkage for one 4 marks = detailed linkage for one or basic for both
Level 3	5-6	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. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.	Level 2 plus detailed linkage to both Amakihi and Palila 5 marks = detailed linkage for one and basic for one 6 marks = detailed linkage for both

Question Number	Answer	Additional guidance	Mark
5(c)	An answer that makes reference to the following points: • molecular phylogeny / analysis of (the sequences in) biological molecules (1) • (therefore) the species with the {most similarities / fewest differences} (are the most closely related) (1)	e.g. DNA, mRNA, proteins	**(2)**

Question Number	Answer	Mark
6(a)	The only correct answer is C Y *A is not correct because W does not contain mitochondria* *B is not correct because X does not contain mitochondria* *D is not correct because Z does not contain mitochondria*	**(1)**

Question Number	Answer	Additional guidance	Mark
6(b)(i)	A description that makes reference to the following points: • named organelle involved in protein production (1) • role of organelle described in the production of the enzyme (1)	mitochondria / nucleus / ribosomes / {rough endoplasmic reticulum / rER} / Golgi (apparatus/body) e.g. mitochondria – produce ATP for protein synthesis (of enzyme) nucleus – site of transcription of enzyme gene / location of gene for enzyme ribosomes -site of protein synthesis / where polypeptide is formed rER -site of protein synthesis / where polypeptide is formed / formation of 3° structure / packaging protein into (transport) vesicle Golgi apparatus – modification of {protein / enzyme} / packaging {protein / enzyme} into (secretory) vesicle	**(2)**

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	• 800		**(1)**

Question Number	Answer	Additional guidance	Mark
6(b)(iii)	An explanation that makes reference to four of the following points: • doubling the acrosin activity of the sperm cell increases the percentage of egg cells fertilised by 68% / non-linear increase • (because) higher acrosin activity means the sperm cells can digest through all of the {outer layer / zona pellucida} (of more egg cells) (1) • (allowing) sperm (cells) to {bind to (egg cell) membrane / enter egg (cell)} (1) • (so that) sperm nucleus can fuse with egg (cell) nucleus / fusion (of nuclei) can occur (1) • (low acrosin activity) could result in death of sperm cells before fertilisation could occur (1)	ACCEPT greater increase (in percentage of egg cells fertilised) between 2.5 and 3(a.u.) ACCEPT 100% fertilisation at 5(a.u.) compared to 32% at 2.5(a.u.) ACCEPT digesting the outer layer {faster /more efficiently} / more digestion occurs Accept converse ACCEPT sperm can reach egg (cell) nucleus ACCEPT sperm can fuse with egg (cell) ACCEPT converse	**(4)**

Question Number	Answer	Additional guidance	Mark
6(c)(i)	• image size divided by magnification	ACCEPT 4.5±1 ÷200 ignore unmanipulated equation	**(1)**

Question Number	Answer	Additional guidance	Mark
6(c)(ii)	An answer that makes reference to three of the following points: • (when a sperm entered egg cell) cortical granules have fused to cell surface membrane / cortical {reaction/enzymes} resulted in hardening of zona pellucida (1) • as zona pellucida (of some egg cells) are damaged there are areas where it is not {present / hardened} (1) • resulting in polyspermy / {an extra / two} sperm have entered (the egg cell) (1)	ACCEPT some zona pellucida is not hardened reject 3 sperm have entered egg cell	**(3)**

Question Number	Answer Additional guidance	Mark
7(a)(i)	The only correct answer is B one *A is not correct because the first statement is correct* *C is not correct because the generative nucleus divides to form two haploid male gametes* *D is not correct because the generative nucleus divides to form two haploid male gametes*	**(1)**

Question Number	Answer	Additional guidance	Mark
7(a)(ii)	• surface area calculated (1) • difference in standard form with units (1)	4.128 (μm^2) 9.02×10^{-1} μm^2	**(2)**

Question Number	Answer	Additional guidance	Mark
7(b)	A description that makes reference to the following points: • differential gene expression (1) • by {epigenetic modification / histone modification / DNA methylation} (1) • {proteins / enzymes} synthesised (from active genes) which (permanently) modify the cell (1) • description of modification to become a sclerenchyma cell	ACCEPT only some genes are {active / switched on} / some genes are switched off ACCEPT {proteins / enzymes} {made / synthesised} produce a {structural / functional / metabolic} change e.g. synthesis of {cellulose/ microfibrils / lignin} / secondary thickening / lignification of cell walls	**(4)**

Question Number	Answer	Additional guidance	Mark
7(c)	An answer that makes reference to four of the following points: • meiosis increases genetic variation / crossing over and {random / independent} assortment occur in meiosis (1) • the {genes / alleles / loci} for colour and grain length are linked (1) • (therefore alleles for these traits) will be inherited together / (therefore alleles for these traits) unlikely to be separated during crossing over (1) • the {genes / alleles / loci} for pea pod wrinkles and {colour/grain length} are not linked (1) • (therefore) the alleles for these traits will be inherited independently due to independent assortment (1)	ACCEPT meiosis results in haploid cells ACCEPT linkage is when {genes / alleles} are close together on the same chromosome ACCEPT allele for this trait may be separated from {colour/grain length/ other alleles} due to independent assortment	**(4)**

Question Number	Answer	Additional guidance	Mark
8(a)	An explanation that makes reference to three of the following points: • fewer young tree shoots eaten (after wolves were reintroduced) (1) • (because) elk would not graze undisturbed when wolves were around (1) • more (young tree shoots) were eaten in forest habitat (than riverside habitat) / fewer (young tree shoots) were eaten in riverside habitat (than forest habitat) (1) • (because) the mature trees provided some {camouflage / protection} (from the wolves) (1)	ACCEPT the percentage (of young tree shoots eaten) decreased ACCEPT converse ACCEPT because some elk have been eaten by wolves / fewer elk because wolves are predators (of elk) ACCEPT {larger/more rapid} decrease (in number of shoots eaten) in riverside habitat ACCEPT (because) elk can hide (from the wolves) in the forest / elk have no {hiding places / protection} from being seen (by the wolves) by the river ACCEPT predation of elk is higher in riverside (habitat)	**(3)**

Question Number	Answer	Additional guidance	Mark
8(b)	A description that makes reference to the following points: • as the number of elk (per km^2) increases the average beaver lifespan decreases (1) • {larger/rapid} decrease {initially / as population increases from 30 elk (per km^2)} (1) • very little change in average lifespan of beavers when the number of elk increase above {70/80/90} elk per km^2 (1)	ACCEPT negative correlation ACCEPT {exponential / non-linear} decrease ACCEPT the beaver lifespan plateaus when the number of elk increase above {70/80/90} elk per km^2	**(3)**

Question Number	Answer	Additional guidance	Mark
8(c)(i)	An answer which includes the following points: • (count) number of species (1) • {area / size} of habitat (1)	 ACCEPT per unit area	 **(2)**

Question Number	Answer	Additional guidance	Mark
8(c)(ii)	• (D =) $\frac{N(N-1)}{\sum n(n-1)}$	ACCEPT other correct equations e.g. simple biodiversity index = species richness ÷ species evenness	**(1)**

Question Number	Answer
***8(d)**	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. 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. <u>Basic</u> • increasing numbers of wolves (until 2003) / decrease in number of wolves (from 2007 to 2010) • overall increase in wolves / 20 more wolves in 2010 (than in 1995) • the numbers of elk decreased as they were hunted by the wolves • overall decrease in numbers of elk (from 1995 to 2010) • the number of cottonwood shoots rapidly increased (after 2003) • the number of beaver colonies increased from 1 (in 1999) to 12 (in 2009) <u>Linkage</u> • the numbers of cottonwood shoots increased {when the numbers of elk decreased / as they weren't being eaten} • beavers and elk have similar niches / beavers were outcompeted for young tree shoots by elk • beaver {numbers/colonies} started to increase when {elk population size decreased / more shoots were available} • discussion of causes of decrease in wolf population e.g. decrease in elk food source • introduction of wolves increases biodiversity <u>Sustained</u> • {more ponds / new habitat} increase {number of species / species richness / biodiversity} • more trees (woodland and riverside habitats) increase {number of species / species richness / biodiversity} • biodiversity increases due to additional species in Yellowstone National Park e.g. wolf **(6)** **Expert**

			Additional guidance
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.	Information from one section
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.	Information from two sections linkage of 2 concepts
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.	Level 2 plus Discussion of how biodiversity would be increased

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