Mark Scheme (Results)

October 2022

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

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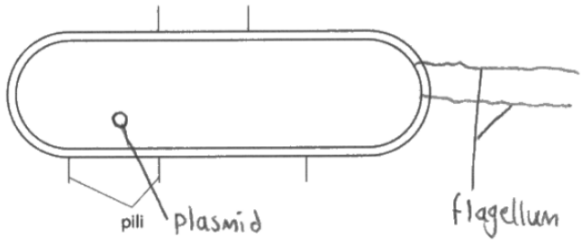
- **General Marking Guidance**

- 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	Mark
1(a)	The only correct answer is C two *A is not correct because eukarya does not contain prokaryotic organisms* *B is not correct because both archaea and bacteria contain prokaryotic organisms* *D is not correct because both archaea and bacteria contain prokaryotic organisms*	**(1)**

Question Number	Answer	Additional guidance	Mark
1(b)(i)	An answer that makes reference to the following point: • flagellum drawn with origin on cell membrane and labelled (1) • plasmid drawn and labelled (1)	<u>Example of diagram</u> 	**(2)**

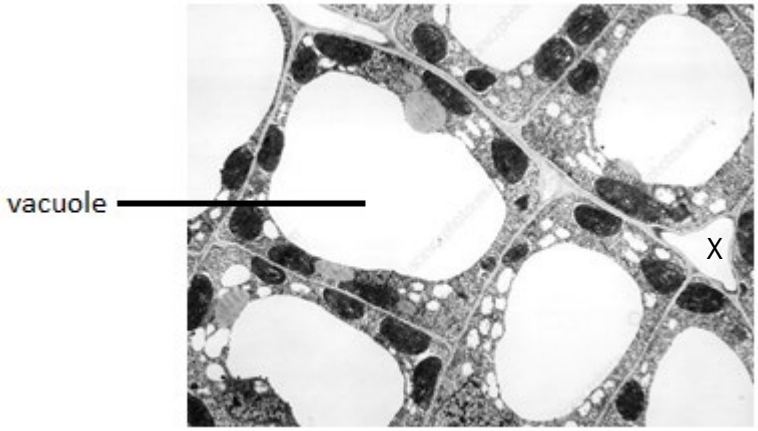
Question Number	Answer	Additional guidance	Mark
1(b)(ii)	• contains {genes / DNA / (genetic) information} to make proteins	Accept to enable horizontal transfer of (genetic) information / used to exchange (genetic) information with other (prokaryotic) cells Accept contains {DNA / (genetic) information} for antibiotic resistance	**(1)**

Question Number	Answer	Additional guidance	Mark
1(c)(i)	An answer that makes reference to the following point: • prokaryotic ribosomes are {70S / small} whereas eukaryotic are {80S / large}	Accept {fewer / only three} strands of rRNA in prokaryote (four in eukaryote) Accept all prokaryotic ribosomes are free floating whereas some eukaryotic ribosomes are attached to membranes	**(1)**

Question Number	Answer	Mark
1(c)(ii)	The only correct answer is B one *A is not correct because ribosomes are located inside chloroplasts and mitochondria* *C is not correct because ribosomes are located on rER and are involved in translation* *D is not correct because ribosomes are located on rER and are involved in translation*	**(1)**

Question Number	Answer	Mark
2(a)	The only correct answer is A 7.3 m^2 *B is not correct because the surface area is 7.3 m^2* *C is not correct because the surface area is 7.3 m^2* *D is not correct because the surface area is 7.3 m^2*	**(1)**

Question Number	Answer	Mark
2(b)	The only correct answer is C two *A is not correct because they both transport dissolved substances* *B is not correct because phloem transport in both directions and phloem walls do not contain lignin* *D is not correct because phloem transport in both directions and phloem walls do not contain lignin*	**(1)**

Question Number	Answer	Additional guidance	Mark
2(c)(i)	An answer that makes reference to the following point: • one (permanent) vacuole correctly labelled (1)	<u>Example of diagram</u> accept label line pointing to tonoplast  	**(1)**

Question Number	Answer	Additional guidance	Mark
2(c)(ii)	A description that makes reference to the following: • provides support (1) • {stores/dissolves} named substance(s) (1)	 e.g. helps to ensure {turgidity / turgor} / maintains osmotic pressure ignore give shape to cell e.g. water, sugars, minerals, proteins, pigments, toxic chemicals, {digestive / hydrolytic} enzymes ignore contains cell sap / nutrients	 **(2)**

Question Number	Answer	Additional guidance	Mark
3(a)(i)	An explanation that makes reference to the following: • magnesium ions to make chlorophyll so {photosynthesis can occur / light energy can be absorbed / glucose can be made} (1) • nitrates are needed to make {amino acids / proteins / polypeptides / DNA / RNA / nucleic acid} (1)	 accept nucleotide / bases / chlorophyll / ATP	 **(2)**

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	An answer that makes reference to one of the following: • {grow/ store} more plants in a given area / less space needed to {grow/ store} the same number of plants (1) • increases profit as increased yield for lower rent (1)	 Accept space saving / increased yield in given area	 **(1)**

Question Number	Answer	Additional guidance	Mark
3(b)(i)	The only correct answer is D 14.39 % *A is not correct because that is the percentage difference for 1 spray with the higher concentration* *B is not correct because that is the percentage difference for 1 spray with the lower concentration* *C is not correct because that is the percentage difference for 2 sprays with the higher concentration*		**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	An answer that makes reference to one of the following: • increasing the number of treatments increases (fruit) firmness / positive correlation between number of treatments and (mean fruit) firmness (1) • increasing the **concentration** of calcium (ions / chloride) increases (fruit) firmness / positive correlation between calcium (chloride) **concentration** and (mean fruit) firmness (1)	accept fruit treated with 3800 mg dm^{-3} were firmer than the fruit treated with 950 mg dm^{-3} ignore references to 'more calcium chloride solution used'	**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)(iii)	An explanation that makes reference to three of the following: • increasing the **concentration** of calcium (ions / chloride) increases (fruit) firmness (1) • (because calcium ions are) needed to make calcium pectate (1) • (forming) middle lamella (1) • more {calcium pectate / middle lamella} formed would mean the cells were (more) firmly held together (1)	Accept {calcium pectate / middle lamella} {increases strength of cell wall / holds cells together}	**(3)**

Question Number	Answer	Additional guidance	Mark
4(a)(i)	An explanation that includes three of the following points: • oxygen for (aerobic) respiration (1) • glucose for {respiration / ATP production} / amino acids for protein synthesis (1) • optimum temperature for {enzyme / metabolic} reaction (1) • water for {hydrolysis reactions / solvent} (1) • optimum pH for {enzyme / metabolic} reaction (1)	accept lack of oxygen for survival of obligate anaerobes accept lipids for synthesis of cell membranes accept suitable stated temperature for {faster/optimum} enzyme activity accept to prevent dehydration accept suitable stated pH for {faster/optimum} enzyme rate of reaction	**(3)**

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	An explanation that makes reference to two of the following points: • oil-based plastic is non-renewable (1) • oil-based plastic {takes a long time to decompose / isn't biodegradable} (1) • contributes to increased carbon dioxide (in atmosphere) / not carbon neutral (1)	accept (oil is a) finite resource / may run out / may not always be available for future generations accept contributes to {global warming/ greenhouse effect}	**(2)**

Question Number	Answer	Additional guidance	Mark
4(b)(i)	An answer that makes reference to three of the following: • bacterial survival decreases over time (on all three boards) (1) • bacterial survival is lowest on pine chopping board (1) • no change in number of bacteria surviving on plastic during first 4 hours (1) • relevant comment about validity of data (1)	 accept converse for plastic accept only significant difference between spruce and plastic is at 4 hours / only slight difference between spruce and plastic at 24 hours accept same survival for {spruce/plastic} after 1 hour e.g. no reference to repeats, no error bars	**(3)**

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	An answer that includes one of the following points: • pine boards have antimicrobial properties (1) • pine chopping boards have a pH outside of bacterial optimum pH (1)	 accept pine boards contain chemicals which kill bacteria accept converse for plastic ignore temperature and water	**(1)**

Question Number	Answer	Additional guidance	Mark
5(a)(i)	• an alternative form of a gene	accept version of a gene	**(1)**

Question Number	Answer	Mark
5(a)(ii)	The only correct answer is A ccddee *B is not correct because all alleles need to be recessive* *C is not correct because all alleles need to be recessive* *D is not correct because all alleles need to be recessive*	**(1)**

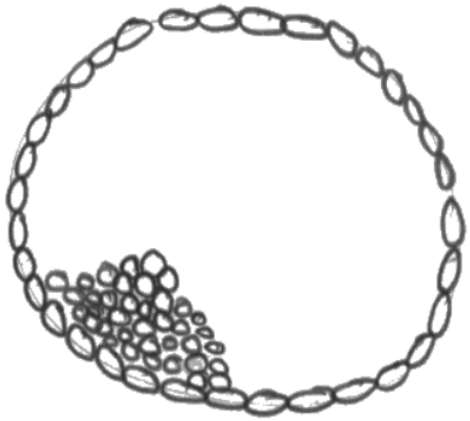
Question Number	Answer	Additional guidance	Mark
5(a)(iii)	A description that includes the following points: • polypeptide chain enters the rER (1) • {secondary/ tertiary} structure formed (1) • polypeptide is packaged into vesicles (by rER) / {(rER) vesicles fuse with / protein enters} Golgi (1) • carbohydrate added (to protein in Golgi) (1) • (glyco)protein is packaged into vesicles (by Golgi) and transported to cell surface membrane (1)	accept 3D structure formed / bonds form between different R groups accept transported in vesicle to the Golgi accept glycosylation occurs (in the Golgi) ignore modification occurs in Golgi without reference to carbohydrate being added accept (glyco)protein is packaged into vesicles (by Golgi) and vesicle fuses with cell surface membrane	**(5)**

Question Number	Answer	Additional guidance	Mark
5(b)	An explanation that includes three of the following points: • the greater the number of recessive alleles the lighter the colour of the seed / the greater the number of dominant alleles the deeper the red colour (1) • random assortment and crossing over results in (gamete) variation (1) • random fertilisation (of gametes) results in (seed) variation (1) • low probability of {inheriting 0/6 recessive alleles / egg cell with no recessive alleles being randomly fertilised by sperm cell with no recessive alleles} (1)	accept converse accept correct statement using information from table e.g. linking a colour to number of recessive alleles / linking colour to frequency / normal distribution accept the gametes vary in the number of {recessive/dominant} alleles they contain accept converse for chance of inheriting {3 recessive / 3 dominant} alleles	**(3)**

Question Number	Answer	Additional guidance	Mark
6(a)(i)	An answer that makes reference to the following: • (step A) mitosis (1) • (step B) meiosis (1)	 accept meiosis **I** do not accept meiosis **I** ignore II	**(2)**

Question Number	Answer	Mark
6(a)(ii)	The only correct answer is A W *B is not correct because the acrosome contains digestive enzymes* *C is not correct because the acrosome contains digestive enzymes* *D is not correct because the acrosome contains digestive enzymes*	**(1)**

Question Number	Answer	Additional guidance	Mark
6(b)	An explanation that includes the following points: • (because) differential gene expression occurs (1) • (due to) epigenetic modification / DNA methylation / histone modification (1) • {transcription of / (active) mRNA made from} active genes (1) • (therefore) translation occurs to form a {polypeptide / protein} (1) • (proteins cause) {structural/functional} change to cells to change them into (specialised) sperm cell (1)	Accept some genes become {switched on / expressed / switched off} Accept description of a {structural/functional} change into a sperm cell	**(5)**

Question Number	Answer	Additional guidance	Mark
6(c)(i)	An answer that includes the following points: • outer layer of cells with internal cell mass (1) • cavity in centre of the diagram (1)	Example of diagram: 	**(2)**

Question Number	Answer	Mark
6(c)(ii)	The only correct answer is D cells that can give rise to almost any type of cell in the body, excluding totipotent cells *A is not correct because pluripotent do not give rise to all cells in the body* *B is not correct because pluripotent do not give rise to all cells in the body* *C is not correct because pluripotent do not give rise to totipotent cells*	**(1)**

Question Number	Answer	Additional guidance	Mark
6(d)	An answer that includes the following points: • (stem cells) can {differentiate / specialise} into different {cells / tissues / organs} (1) • great {potential/ importance/ medical implications} of the research in developing medical therapies (1) • salamander embryos do not have a fully developed nervous system (1) • no need to use human embryos (1)	accept named example of a medical therapy use of stem cells in humans e.g. {repair / transplant} {cells / tissues / organs} in humans accept will save human lives / used to treat certain diseases e.g. cancer / heart disease accept salamander embryos do not feel pain / salamanders are not an endangered species / salamanders produce a large number of embryos	**(2)**

Question Number	Answer	Additional guidance	Mark
7(a)	• the number of species within a {defined region / habitat / community}.	accept {amount / variety} of species in an area do not accept number of organisms in **a** species in a given area	**(1)**

Question Number	Answer
***7(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. <u>New species formation</u> • reproductive / geographical isolation • due to cichlid population being {separated / entrapped} into different lakes / isolation can occur in different habitats within same lake • recognition that Apoyo was first inhabited before Xiloá • recognition that cichlids can move between the two great lakes but not between the crater lakes • mutation causes new allele / genetic variation in original cichlid population • selection pressures different in different lakes • different alleles may give selective advantage in different lakes • fish with advantageous alleles survive, reproduce and pass these alleles onto their offspring • description of allele frequency increasing • different phenotypes developed due to different genotype • speciation first occurred in lake Apoyo / link to {long time/ 1000 years +} for first speciation to occur in lake {Apoyo / Xiloá} <u>Determination of 6 different species</u> • analysing phenotype similarities and differences • examples from photographs given • analysing biological molecules using molecular phylogeny e.g. DNA, RNA, proteins • details of methodology used to analyse the molecules • cichlids are different species as no longer able to breed together to produce fertile offspring • due to different {body shape / breeding behaviours etc} • discussion of how the molecular phylogeny results would support the cichlids being different species **(6)**

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	Demonstrates isolated elements of biological knowledge related to the given context with generalised comments made. The description will contain basic information with some attempt made to link knowledge and understanding to the given context.	Basic description of either how the new species may have formed in these four lakes or how the scientists would have determined that these cichlids were 6 different species
Level 2	3-4	Demonstrates adequate knowledge by selecting and applying some relevant biological facts/concepts to provide the description being presented. The description shows some linkages and lines of reasoning with some structure.	Basic description of new species formation and determination of new species or Detailed description of new species formation
Level 3	5-6	Demonstrates comprehensive knowledge by selecting and applying relevant knowledge of biological facts/concepts to provide the description being presented. The description is clear, coherent and logically structured.	Detailed description of either how the new species may have formed in these four lakes And how the scientists would have determined that these cichlids were 6 different species

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>7(c)</td>
<td>An answer that includes the following points:

• N(N-1) correctly calculated (1)

• ∑n(n-1) correctly calculated and inserted into formula (1)

• calculation of D for lake Apoyo (1)

• lake Apoyo has higher biodiversity (as 3.05 is larger than 2.8) (1)</td>
<td>
<table>
<tr><th>Species</th><th>Number of individuals (n)</th><th>n(n-1)</th></tr>
<tr><td>A. astorquii</td><td>156</td><td>24180</td></tr>
<tr><td>A. chancho</td><td>45</td><td>1980</td></tr>
<tr><td>A. flaveolus</td><td>78</td><td>6006</td></tr>
<tr><td>A. globosus</td><td>8</td><td>56</td></tr>
<tr><td>A. supercilius</td><td>17</td><td>272</td></tr>
<tr><td>A. zaliosus</td><td>12</td><td>132</td></tr>
<tr><td></td><td>(N)=316</td><td>∑n(n-1)=32626</td></tr>
</table>

D= 3.0509 / 3.05 / 3.051 / 3.1 / 3.0 / 3

ecf applies
</td>
<td>(4)</td>
</tr>
</table>

Question Number	Answer	Additional guidance	Mark
7(d)	An answer that includes the following points: • q^2 correctly calculated (1) • ($\sqrt{p^2}$=0.6 and) **$\sqrt{q^2}$=**0.4 (1) • allele frequency has {not changed / remained the same} (1)	128÷800 or = 0.16 no ecf ecf applies from incorrect p and q values in working	**(3)**

Question Number	Answer	Additional guidance	Mark
8(a)	A description which includes the following points: • synthesis of organelles (1) • increase in cell size / growth of cell (1) • {synthesis / replication} of DNA (1)	ignore references to G1, S and G2 accept {replication / increasing number} of organelles accept synthesis of {proteins / enzymes} required for the next part of the cell cycle accept increase in cytoplasm ignore growth of organelles accept {DNA / genetic material} is doubled	**(3)**

Question Number	Answer	Additional guidance	Mark
8(b)	An answer that includes four of the following points: • {methyl groups / CH_3} are added to {DNA / the gene/ cytosine} (1) • (resulting in RB) gene being {switched off / silenced} (1) • (methylation) prevents the binding of {RNA polymerase / transcription factors} (1) • (therefore) translation (of mRNA) does not occur (1) • (therefore the) {RB / tumour suppressor} protein isn't produced (1) • and {the cell cycle / mitosis} continues (forming a tumour) / {reduced / no} inhibition of tumour growth (1)	ignore methylation of the gene accept gene is not {expressed / active} accept {no / reduced} transcription of (RB) gene / mRNA is not produced (from RB gene) accept fewer {RB / tumour suppressor} proteins are produced accept higher rate of cell division occurs	**(4)**

Question Number	Answer	Additional guidance	Mark
8(c)	An explanation that includes the following points: • (sister) chromatids cannot be separated / centromere cannot be split (1) • during anaphase (1)	accept chromosomes won't {be separated / move to poles of cell / move away from equator} accept cell remains in metaphase	**(2)**

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. • increasing concentration of Paclitaxel {increases the duration of mitosis / slows mitosis} • quantitative comparison using information from table • increasing concentration of Paclitaxel increases the mitotic index • quantitative comparison using information from table • Paclitaxel causes the lowest increase in mass of tumour / lowest mass of tumour with paclitaxel • Paclitaxel was more effective than {placebo / drug X} • quantitative comparison using information from graph • error bars for paclitaxel do not overlap with {drug X / placebo} so there is a significant difference / error bars for drug X and placebo overlap so {the data may not be completely reliable / have similar effectiveness} / correct comment about size of error bars linked to repeatability of data • recognition that there is a significant difference between {placebo/drug X} and paclitaxel data • relevant comment about study design e.g. sample size, no information about age/sex etc of volunteers, no given duration in human lung study, only 21 days in mouse study • paclitaxel stopped division of cancerous cells / {fewer / decreased rate of} cancer cells being produced with paclitaxel • linkage between {increased mitotic index/ slower rate of mitosis / fewer cancer cells produced by mitosis} and smaller mass of tumour • explanation of how mitotic index is calculated (number of cells in mitosis ÷ total number of cells) • linkage between the increased duration of mitosis and the increased mitotic index e.g. more cells in prophase, metaphase, anaphase, telophase than in interphase • linkage between prevention of shortening of spindle fibres and increased duration of mitosis/mitotic index • resulting in, fewer cells in {anaphase/telophase/cytokinesis} than {prophase/metaphase} **(6)**

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	Limited scientific judgement made with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Basic evaluation of either the effectiveness of Paclitaxel on lung tumours in humans or the effectiveness of Paclitaxel on breast tumours in mice
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Basic evaluation of the effectiveness of Paclitaxel on lung tumours in humans and the effectiveness of Paclitaxel on breast tumours in mice OR detailed evaluation of either the effectiveness of Paclitaxel on lung tumours in humans or the effectiveness of Paclitaxel on breast tumours in mice
Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Detailed evaluation of the effectiveness of Paclitaxel on lung tumours in humans and the effectiveness of Paclitaxel on breast tumours in mice

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