GradeMax



Mark Scheme (Results)

January 2022

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

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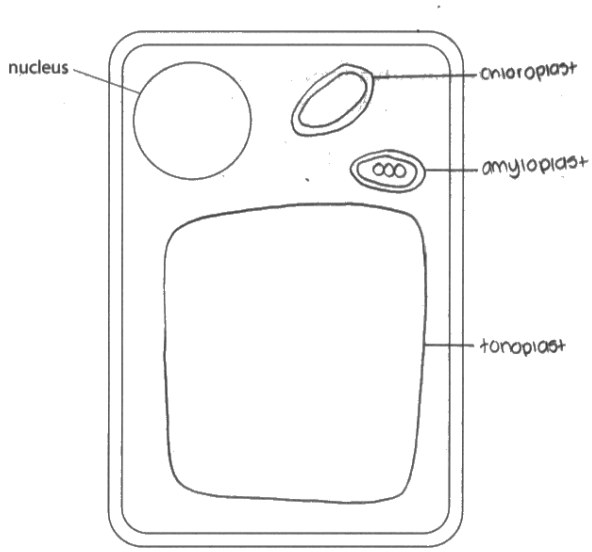
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General Marking Guidance

- 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 points: • amyloplast drawn and labelled (1) • chloroplast drawn and labelled (1) • tonoplast drawn and labelled (1)	<u>Example of diagram</u>  {amyloplast/chloroplast} < nucleus < tonoplast ignore internal details of structure do not accept the wrong location for the structures do not accept double membrane on tonoplast tonoplast label should touch membrane	**(3)**

Question Number	Answer	Additional guidance	Mark
1(b)	• modifies and packages {proteins/enzymes} / processes and packages lipids	ACCEPT modifies {proteins/enzymes/lipids} / packages {proteins/enzymes/lipids} do not accept synthesises proteins do not accept ref to proteins being packaged for transport to GA	**(1)**

Question Number	Answer	Mark
1(c)		**(4)**

Structure	Archaea only	Bacteria only	Eukarya only	More than one domain
Cell membrane	☒	☒	☒	☒
nucleolus	☒	☒	☒	☒
cell wall	☒	☒	☒	☒
70S (small) ribosome	☒	☒	☒	☒

Question Number	Answer	Additional guidance	Mark
2(a)	• (adding a stain) allows structures to be seen / {differentiate / increase contrast} between structures	e.g. chromosomes, DNA, lignin, organelles etc ACCEPT show detail more clearly ACCEPT converse argument for specimens which are not stained ignore to make specimens more visible	**(1)**

Question Number	Answer	Additional guidance	Mark
2(b)	An explanation that includes four of the following points: • cellulose molecules can be organised into microfibrils. (1) • (due to layers of) {cellulose / microfibrils} arranged in {different directions / a mesh} (1) • {hydrogen bonds in cellulose molecules / hydrogen bonds in microfibrils / layers (of microfibrils) / lignin / secondary thickening / pectate} add {strength / support / stability} (1) • {(cellulose) microfibrils / mesh} held together by {pectin / pectate} (1) • lignin makes {outside of xylem vessels / cell wall} impermeable (to water) (1) • the structure of lignin described (1)	ACCEPT lignin arrangement contributes to {rigidity / flexibility} (of vessel) ACCEPT cellulose microfibrils can't slide over each other ACCEPT lignin makes {cell walls / xylem} waterproof e.g. rings, spirals, ladders	**(4)**

Question Number	Answer	Additional guidance	Mark
3(a)	A calculation in which: • calculation of volume of liposome (1) • expressed in standard form (1)	<u>Example of calculation:</u> 220893 2×10^5 / 2.2×10^5 / 2.21×10^5 (nm^3) answer given to 3 sig fig ecf applied for mp2 for correct volume calculation using 75 as radius	**(2)**

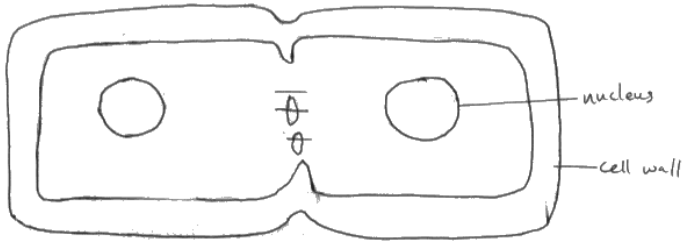
Question Number	Answer	Additional guidance	Mark
3(b)	An explanation that makes reference to the following points: Similarities • both are single-stranded (1) • both contain the bases A,U,C,G / both contain a base, phosphate group and ribose (sugar) / both contain phosphodiester bonds (1) • an exon on pre-mRNA contains same base sequence as the matching exon on active mRNA (1) Differences • pre-mRNA contains both introns and exons whereas active RNA only contains exons (1) • active mRNA may have {fewer / different order of} exons (than pre-mRNA) (1)	ACCEPT linear ACCEPT both do not contain thymine ACCEPT both contain RNA nucleotides / both contain uracil ACCEPT both contain exons ACCEPT pre-mRNA contains introns whereas active RNA does not ACCEPT pre-mRNA is {longer / has more bases} than active mRNA ACCEPT pre-mRNA has recognition site for splicesome whereas active RNA does not ACCEPT active mRNA has a different base sequence to pre-mRNA	**(4)**

Question Number	Answer	Mark
4(a)(i)	The only correct answer is B K *A is not correct because the DNA content is not doubling* *C is not correct because the DNA content is not doubling* *D is not correct because the DNA content is not doubling*	**(1)**

Question Number	Answer	Mark
4(a)(ii)	The only correct answer is B L *A is not correct because the chromosomes are not condensing* *C is not correct because condensation of chromosomes would have completed before metaphase begins* *D is not correct because the chromosomes are not condensing*	**(1)**

Question Number	Answer	Additional guidance	Mark
4(b)(i)	• prophase		**(1)**

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation that makes reference to two of the following points: • the {attachment/binding} of centromeres (to the spindle fibres) (1) • to allow the separation of the {(daughter) chromatids / chromosomes} (1) • so that each daughter cell gets identical genetic material (1)	 ignore sister ACCEPT contract to move {chromatids /chromosomes} to opposite {poles/ends of cell} ACCEPT same number of chromosomes	**(2)**

Question Number	Answer	Additional guidance	Mark
4(b)(iii)	An answer that makes reference to the following points: • cell wall and nuclear envelopes {present / reforming} (1) • cell plate visible (1)	<u>Example of diagram</u>  cell wall either labelled or cell has two outer lines ACCEPT phragmoplast	**(2)**

Question Number	Answer	Additional guidance	Mark
4(c)	A description that makes reference to the following: • count number of cells in mitosis and the total number of cells (1) • divide the number of cells in mitosis by the total number of cells in the photograph (then multiply the answer by 100) (1)	 ACCEPT named stages of mitosis ACCEPT correct equation	**(2)**

Question Number	Answer	Additional guidance	Mark
5(a)(i)	• correct magnification calculated	ACCEPT range between x 14 000 - x 18 000 ACCEPT correct magnification in standard form	**(1)**

Question Number	Answer	Additional guidance	Mark
5(a)(ii)	An answer that makes reference to the following point: • too small (0.5 µm) to be viewed (under a light microscope) / magnification (of x 14 000-16 000) can't be achieved by a light microscope / resolution would be too low} (1)	ecf applies ignore references to 3D image	**(1)**

Question Number	Answer	Additional guidance	Mark
5(b)	An explanation that makes reference to two of the following points: • plant based packaging is (more) sustainable / biodegradable / carbon neutral (than traditional oil-based packaging) (1) • (the antimicrobial property of the oregano oil) will {reduce the numbers of (*L. monocytogenes*) bacteria / prevent bacterial growth (on the food) / prevent microbial growth} (1) • (resulting in) fewer people getting {listeriosis / (microbial) disease} (1)	ACCEPT plant-based packaging is {renewable / available for future generations} ACCEPT kill bacteria ignore reduce microbes entering packaging ACCEPT so food will not go off as quick / extends shelf life	**(2)**

Question Number	Answer	Mark
5(c)(i)	The only correct answer is C *A is not correct because L. monocytogenes is least affected by the chemicals* *B is not correct because L. monocytogenes is least affected by the chemicals* *D is not correct because L. monocytogenes is least affected by the chemicals*	**(1)**

Question Number	Answer	Additional guidance	Mark
5(c)(ii)	• 6.14 / 6.1 / 6	<u>Example of calculation:</u> 11.1+0.63=11.73 6.0-0.41=5.59 11.73-5.59=6.14	**(1)**

Question Number	Answer	Additional guidance	Mark
5(d)	A description that makes reference to the following points: • to test for side-effects (1) • to determine {safe / minimum /effective/ suitable} {dosage / concentration} (1) • to determine if it is more effective than {existing treatments / placebo} (1)	 ignore to check for safety do not accept testing for side effects in context of {in-vitro/animal} ACCEPT to {determine optimum dosage / adjust dose} ACCEPT compare effectiveness with {existing treatments / placebo} ignore to see if it's effective	**(3)**

Question Number	Answer
***6(a)**	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. • description of table data e.g., the more dominant alleles present in the zygote increases the darkness of the skin, • description of polygenic inheritance • recognition that {3 genes / 6 alleles} involved with this phenotype / each gamete contains 3 alleles involved with this phenotype • description of graph data • e.g., phenotype shows normal distribution / phenotype shows continuous variation • e.g., offspring have highest probability of inheriting {3 dominant alleles/medium skin colour} • consideration that large variation due to crossing over of {genetic material / allele / DNA} in prophase I • description of crossing over • consideration that large variation due to random assortment of chromosomes in metaphase I • description of random assortment • consideration that random fertilisation of genetically different gametes increases variation • consideration of probability of different types of mutation e.g., silent • consideration of {environmental variation / mutation} increasing variation e.g. sun tan, DNA methylation • explanation of how {environmental variation / mutation} would increase variation e.g. pigment production **(6)**

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	Limited number of the most important or relevant scientific factors from the data/information provided are synthesised. No judgement is made.	1-2 sections
Level 2	3-4	Some of the most important or relevant scientific factors from the data/information provided are synthesised. A limited accurate judgement is made.	3-4 sections
Level 3	5-6	Most of the important or relevant scientific factors from the data/information provided are synthesised. A detailed and accurate judgement is made.	5-6 sections

Question Number	Answer	Additional guidance	Mark
6(b)	An answer that makes reference to two of the following points: • {increased/ more} exposure to {UV/sun} light (would result in a darker skin tone) (1) • mutation could result in {production of a protein which would result in a darker skin tone / fewer melanocytes} (1) • limited food source containing materials for pigment synthesis / disease killing pigment cells (1)	ignore different exposure to sunlight ignore may be using fake tan (unless qualified with a drug form) ACCEPT mutation may have occurred ACCEPT epigenetic modification ACCEPT skin cancer / disease	**(2)**

Question Number	Answer	Additional guidance	Mark
7(a)	• (species richness) is the number of (different) species in a habitat	ACCEPT number of (different) species in an {area/ecosystem}	**(1)**

Question Number	Answer	Additional guidance	Mark
7(b)	An explanation that makes reference to two of the following points: • extends storage time of the seeds (1) • (because drying) prevents germination of seeds / keeps seeds dormant (1) • (because removal of water) slows {enzyme activity / metabolic reactions (in seed cells)} (1)	ACCEPT {prevents/reduces} microbial growth / reduces decomposition / prolongs life of seed ACCEPT reduces germination ignore so seeds don't grow unqualified ACCEPT (therefore) enzymes are not activated ACCEPT prevents destruction of cells due to ice formation ignore reduces freezing effect	**(2)**

Question Number	Answer	Additional guidance	Mark
7(c)(i)	• heterozygosity index = no of heterozygotes ÷ number of individuals (in the population/species)		**(1)**

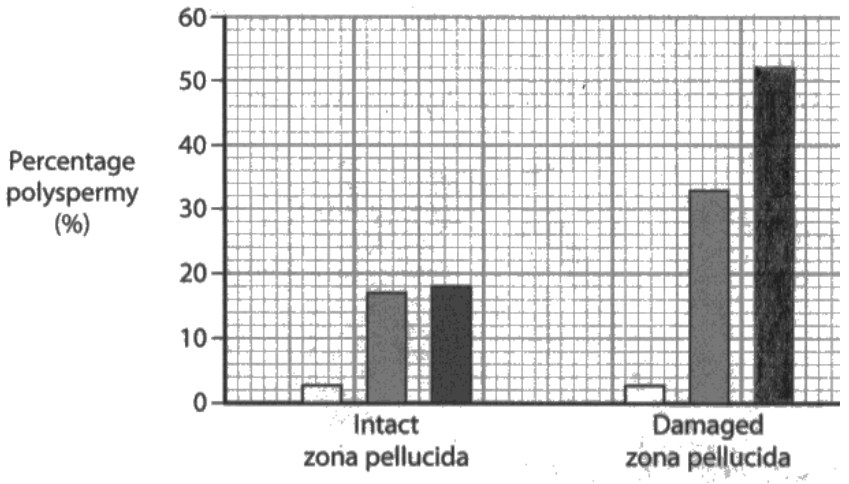
Question Number	Answer	Additional guidance	Mark
7(c)(ii)	83		**(1)**

Question Number	Answer
***7(c)(iii)**	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. Grow more plants produced via asexual reproduction in botanical gardens • increasing population • but all genetically identical / no effect on genetic diversity • low genetic diversity could lead to decreased chance of survival if environment changes • more plants mean more opportunities to collect pollen / pollinate other Titan arum plants Collecting pollen when an individual plants flowers and storing it in a seedbank • pollen available (for artificial pollination) when an individual plant flowers • consideration of local seedbank in Sumatra and others in strategic locations around the world as transporting pollen around the world may {delay / prevent} successful fertilisation • ability to select pollen which comes from individuals with different alleles / consideration of possibility of collecting pollen with {same alleles / low genetic diversity} • consideration of viability of stored pollen / cost to store pollen Studbook for the species • consideration of analysing the genetic material of all of the individual plants throughout the world • decide which pollen would be used to fertilise which flowering plant • selective breeding could increase genetic diversity Artificially pollinate plants in the wild and in botanical gardens • individual plants may not be able to be fertilised naturally / more successful than relying on insect pollination • possible reasons why e.g. only Titan arum plant in the botanical garden • so artificially pollinating would result in population increasing faster • consideration of {short timescale for pollination / cost / labour intensive method} • ability to select pollen which comes from individuals with different alleles / could increase genetic diversity **(6)**

			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.	consideration of one or two of the scientists suggestions 1 mark = basic consideration of one suggestion 2 marks - basic consideration of two suggestions **or** detailed consideration of one suggestion
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.	3 marks - basic consideration of three suggestions **or** detailed consideration of two suggestions 4 marks - more detailed consideration of three suggestions
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.	5 marks - basic consideration of four suggestions 6 marks - detailed consideration of four suggestions

Question Number	Answer	Additional guidance	Mark
8(a)	An answer that makes reference to the following points: • packaged into a (secretory) vesicle by the Golgi {apparatus / body} (1) • (vesicle) fuses with cell surface membrane to release them outside of the cell (1)	ACCEPT transported from the Golgi {apparatus / body} in (secretory) vesicles ACCEPT exocytosis ACCEPT exocytosis in wrong context e.g. acrosomes	**(2)**

Question Number	Answer	Additional guidance	Mark
8(b)	An answer that makes reference to the following points: • individual sperm have slower speeds than bundled sperm (in all resistances) (1) • increase in resistance (above 0.5) decreased the speed of individual sperm more than bundled sperm / individual sperm speed decreases with increased resistance whereas bundled sperm speed {increases / stays relatively constant} (1) • (because) {bundles of sperm / more flagella} can generate more force (1) • {lower confidence / no significant difference} in results for 0.5 resistance due to overlap of {SD / error / range} bars / resistance has little effect on the speed of the sperm bundle as the error bars for each of the resistance overlap (1)	ACCEPT converse ACCEPT {largest / quoted comparative} difference in speed at 4.0 resistance / bundled sperm have double the speed at 4.0 resistance ACCEPT converse ACCEPT converse for other viscosities	**(4)**

Question Number	Answer	Additional guidance	Mark
8(c)(i)	• correctly plotted bar with shading (1)		**(1)**

Question Number	Answer	Additional guidance	Mark
8(c)(ii)	An explanation that makes reference to four of the following points: • there was more polyspermy of egg cells when the zona pellucida was damaged / converse for intact zona pellucida (1) • due to cortical reactions only occurring over some part of the egg cell (1) • (therefore some) areas of the egg cell not being covered by a hardened zona pellucida (1) • there was more polyspermy of egg cells with a higher sperm concentration • increased sperm cell concentration increased the likelihood of sperm cells entering {egg cell before cortical reaction occurred / through gap in hardened zona pellucida} (1)	ACCEPT {fewer/no} cortical reactions (with damaged zona pellucida) / converse for intact zona pellucida ACCEPT (therefore damaged) zona pellucida does not {harden / thicken} / converse for intact zona pellucida ACCEPT increased sperm cell concentration increased the {concentration of digestive enzymes / rate of digestion of zona pellucida} ignore increased {concentration / damaged to zona pellucida} increases number of sperm reaching the egg cell	**(4)**

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

Question Number	Answer	Additional guidance	Mark
9(b)(i)	An answer that makes reference to the following: • anatomical (1) • anatomical (1) • behavioural (1)		**(3)**

Question Number	Answer	Additional guidance	Mark
9(b)(ii)	An answer that makes reference to one of the following points: • competition for a {mate / territory} (1) • competition for food / height of food (1)	ignore mutation ACCEPT predators e.g. more food sources above height of shell	**(1)**

Question Number	Answer	Additional guidance	Mark
9(c)(i)	A calculation in which: • calculation of percentage using correct data (1)	<u>Example of calculation:</u> (18÷27) × 100 = 66.67% / 66.7% / 67%	**(1)**

Question Number	Answer	Additional guidance	Mark
9(c)(ii)	A calculation in which: • calculation of increase in population (1) • calculation of percentage increase using correct data (1)	<u>Example of calculation:</u> 1800-15 = 1785 (1785÷15) × 100 =11 900.0 %	**(2)**

Question Number	Answer	Additional guidance	Mark
9(c)(iii)	An explanation that makes reference to three of the following points: • analysis of molecular evidence (of the zoo tortoise) (1) • comparison (of molecular evidence) to a *C. hoodensis* tortoise (to see how similar the sequences are) (1) • comparison of {phenotype /anatomy/physiology} to a *C. hoodensis* tortoise (1) • breeding the tortoise with a *C. hoodensis* tortoise to see if **fertile** offspring are produced (1)	e.g. DNA / RNA / proteins ACCEPT molecular phylogeny ACCEPT comparison of bands (from gel electrophoresis) with *C. hoodensis* tortoise ACCEPT identification of features {exclusive/similar} to *C. hoodensis*	**(3)**

Question Number	Answer	Additional guidance	Mark
9(d)	An explanation that makes reference to two of the following points: • DNA analysis to identify different alleles (1) • use of Hardy-Weinberg equation / $p^2+2pq+q^2$ (1) • (in order to) compare (recessive) allele frequency in previous generation(s) with current generation (1)		**(2)**

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