Mark Scheme (Results)

January 2024

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)	an answer between 2.5 to 2.7 m	both height and unit required for the mark accept correct answers (whole number only) in cm accept no more than 2 dp if in m	**(1)**

Question Number	Answer	Additional guidance	Mark
1(b)(i)	• phloem	ignore vascular bundle	**(1)**
Question Number	**Answer**	**Additional guidance**	**Mark**
1(b)(ii)	A description that makes reference to two of the following points: • {(continuous) tube / hollow tube / sieve plate} allows {flow of solution / movement of sucrose / translocation} (1) • contain plasmodesmata allow {entry /exit} of {sucrose / water / molecules} (1) • companion cells to {move sucrose into sieve tube (elements) provide ATP for active transport} (1) • (cellulose) cell wall to withstand pressure (1)	ecf for xylem/sclerenchyma/vascular bundle only • {(continuous) tube / hollow tube} allows transport of {water / mineral ions} (1) • pits allow {water / mineral ions} to move to adjoining {cells / vessels} (1) • {lignin / secondary thickening} {make vessels walls impermeable to water / water can only leave through pits / withstand hydrostatic pressure / provide support} • thick cell wall to {withstand hydrostatic pressure / provide support} (1) sclerenchyma:	**(2)**

		• {lignin / secondary thickening} provide support	

Question Number	Answer	Mark
1(c)(i)	The only correct answer is C 2 and 3 only *A is not correct because sclerenchyma and xylem contain lignin* *B is not correct because sclerenchyma and xylem contain lignin*	**(1)**

Question Number	Answer	Additional guidance	Mark
1(c)(ii)	An answer that makes reference to two of the following points: • (it has {support / stability} from {(bamboo) pole / another object} (1) • (needs to be flexible to) {grow / bend / wraps} around the {(bamboo) pole / another object / supporting object} (1)	accept lignin provides {strength / support / rigidity} (to cell wall) / converse for low lignin accept climbing plant) doesn't need to be as rigid / needs to be flexible / doesn't need as much support / converse for sunflower accept converse for sunflower plant ignore {growing up / climbing} the pole	**(2)**

Question Number	Answer	Mark
2(a)	The only correct answer is B capsule and pili *A is not correct because flagellum* are not involved in adhesion *C is not correct because flagellum* are not involved in adhesion *D is not correct because flagellum* are not involved in adhesion	**(1)**

Question Number	Answer	Additional guidance	Mark
2(b)(i)	An explanation that makes reference to two of the following points: • will not run out / more plants can be grown / renewable / available to future generations (1) • biodegradable / can be broken down **by {decomposers / bacteria / fungi}** (more rapidly) (1) • carbon neutral (1)	ignore decompose unqualified	**(2)**

Question Number	Answer	Additional guidance	Mark
2(b)(ii)	An answer that makes reference to the following points: • there is a reduction in bacteria with poplar, pine and polystyrene / there is a reduction in number of bacteria with all packaging (1) • decrease in bacteria is due to antimicrobial properties (1) • pine {is the **most** effective (packaging) / has **most** antimicrobial properties} (1) • relevant comment on {SD / sample size / suitable variable} (1)	accept correct statement about decrease in numbers of bacteria for one packaging type e.g. pine has greatest decrease / plant-based has bigger decrease / oil-based have insignificant decrease accept {poplar / pine / polystyrene} (packaging) {have antimicrobial properties / produce chemicals which kill bacteria} / plant-based products have antimicrobial properties accept a given antimicrobial property e.g. low pH accept {plant-based / wood} packaging is **more** effective (than oil-based) accept pine (packaging) is **more** effective than poplar (at reducing bacterial growth) ignore HDPE is least effective e.g. {significant difference between the / valid} results due to no overlapping of SD / poplar wood results have lower reliability due to largest SD ignore {lower reliability / validity} due to only 4 groups accept no information on how many fish were in each group / no information on {type/age} of fish	**(4)**

Question Number	Answer	Mark
3(a)(i)	The only correct answer is B behavioural *A is not correct because migration is an example of a behavioural adaptation* *C is not correct because migration is an example of a behavioural adaptation* *D is not correct because migration is an example of a behavioural adaptation*	**(1)**

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	1328	accept 1.328×10^3 ignore 1.3×10^3 and 1.33×10^3	**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)	An explanation that makes reference to the following points: • population size would have reduced (1) • (as fewer milkweed plants mean) fewer eggs will {be laid / hatch / survive} / fewer offspring produced / fewer butterflies will be available to reproduce (in next generation) / fewer {places / plants} to lay eggs (1) • (fewer reproducing butterflies) could result in reduced genetic diversity (of butterfly population) (1)	ignore **no** eggs will be laid / **no** place to lay eggs ignore fewer eggs are fertilised unless linked to future generation(s) e.g. fewer eggs fertilised means fewer butterflies to reproduce (next year) accept decreased reproduction rate ignore mutation could result in increase in genetic variation ignore inbreeding might occur ignore references to genetic diversity of milkweed	**(3)**

Question Number	Answer	Additional guidance	Mark
3(c)(i)	• {many genes / gene**s** at **different** loci} contribute to {the rate of egg laying / this characteristic) (1)	ignore alleles unless correctly qualified accept {many genes / gene**s** at **different** loci} contribute to the characteristic / trait / phenotype	**(1)**

Question Number	Answer	Additional guidance	Mark
3(c)(ii)	• graph showing normal distribution (1) • both axes labelled correctly (1)	accept peak shifted to left or right accept suitable labels e.g. x axis = phenotype / characteristic / rate of egg laying y axis = frequency / number of {hens / individuals} ignore population <u>Example of graph</u>  accept graphs which do not start at 0	**(2)**

Question Number	Answer	Mark
4(a)(i)	The only correct answer is C 1250 minutes *A is not correct because it would take 75 000 seconds or 1250 minutes* *B is not correct because it would take 75 000 seconds or 1250 minutes* *D is not correct because it would take 75 000 seconds or 1250 minutes*	**(1)**

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	• (measure the) {image size / length of pollen tube} and then divide by {magnification / 100}	accept correct manipulated equation but ignore unmanipulated equation accept A=I/M ignore magnitude accept calibrate an eyepiece graticule with stage micrometer (to calculate the actual size) ignore use graticule unqualified	**(1)**

Question Number	Answer	Additional guidance	Mark
4(b)	An explanation that makes reference to four of the following points: • the female gamete(s) **and** the male nuclei are haploid (1) • female gamete **nucleus** was fertilised by {one / a} male {nucleus / gamete} (to form the embryo cell) (1) • embryo (cell) is {2n / diploid} (1) • (whereas two) polar nuclei were fertilised by {one / a} male {nucleus / gamete} (to form the endosperm cell) (1) • an endosperm (cell) is {3n / triploid} (1)	accept {egg cell/ovum} for female gamete can refer to tissue or cell ignore sperm reject generative nucleus reject generative nucleus accept zygote is {2n / diploid} ignore descriptions of diploid reject generative nucleus	**(4)**

Question Number	Answer	Additional guidance	Mark
4(c)	An answer that makes reference to five of the following points: • (drug containing *L. candidum*) extract tested on human (skin) {cells / tissues} (1) • appropriate {dosage / concentrations} (of drug containing *L. candidum* extract) identified / identification of {side effects / toxicity} (1) • (phase 1 / preliminary) tests on (people / volunteers) who {are healthy / do not have skin burns} (1) • (phase 2) - drug tested on {small / 100 to 500} groups of (patients / people) **who have (skin) burns** (1) • (phase 3) - drug tested on {large groups of / 1000 to 3000} (patients / people) **who have (skin) burns** (1) • double blind test involves one group receiving extract and the other receiving current (skin burn / hospital) treatment (1)	accept tested on animals ignore 'safe' / safety of drug ignore patients unqualified ignore patients unqualified ignore double blind unqualified / placebo group accept compare extract data to current skin treatment ignore peer review	**(5)**

Question Number	Answer	Additional guidance	Mark
5(a)(i)	An answer that makes reference to the following point: • chloroplast is the site of {photosynthesis / glucose production / light absorption} (1)	accept site of light {dependent / independent} reactions / site of carbohydrate production / converts light energy into chemical energy / ignore produces ATP (unless qualified with light dependent stage / ETC) ignore store starch ignore production of oxygen	**(1)**

Question Number	Answer	Additional guidance	Mark
5(a)(ii)	An answer that makes reference to the following points: • (transmission) electron microscope (1) • high resolution / allows {the (ultra)structure of the chloroplast to be seen / detailed image} (1)	ignore scanning / electric / electronic allow TEM / electron / EM ignore the image is clear ignore magnification	**(2)**

Question Number	Answer	Additional guidance	Mark
5(b)(i)	• number of (different) species in a {community / this part of the lake / specific area / habitat / ecosystem} (1)	ignore variety of species ignore number of **a** species	**(1)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>5(b)(ii)</td><td>An answer that includes the following points:

• calculation of N(N-1) (1)

• calculation of ∑n(n-1) (1)

• calculation of D to 2 d.p. (1)</td><td>
<table>
<tr><th>Species</th><th>Number of individuals (n)</th><th>(n-1)</th><th>n(n-1)</th></tr>
<tr><td>A</td><td>54</td><td>53</td><td>2862</td></tr>
<tr><td>B</td><td>12</td><td>11</td><td>132</td></tr>
<tr><td>C</td><td>3</td><td>2</td><td>6</td></tr>
<tr><td>D</td><td>31</td><td>30</td><td>930</td></tr>
<tr><td>E</td><td>7</td><td>6</td><td>42</td></tr>
<tr><td>F</td><td>46</td><td>45</td><td>2070</td></tr>
<tr><td></td><td>Total (N) = 153</td><td></td><td>∑n(n-1) =6042</td></tr>
</table>
$D = \frac{23256}{6042}$
D = 3.85
ecf applies</td><td>(3)</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>5(b)(iii)</td><td>• (the New Zealand pygmy weed has) reduced the {diversity / index / D} of this part of the lake (1)

• (due to blocking light) causing death of plants / reduction of {food / habitats} for other organisms (1)</td><td>ecf applies from (ii)

accept it (out)competed {native species / other plants} / some species {died / left}
ecf applies from (ii) e.g. {food source / habitat} for new species</td><td>(2)</td></tr>
</table>

Question Number	Answer	Additional guidance	Mark
6(a)	see table below	1 mark per correct row do not credit hybrid tick/cross	**(4)**

Structure	Animal cell ✓ or X	Plant cell ✓ or X	Prokaryotic cell ✓ or X
amyloplast	X	✓	X
circular DNA	✓	✓	✓
mitochondria	✓	✓	X
nucleolus	✓	✓	X

Question Number	Answer	Mark
6(b)	The only correct answer is A 4.2×10^{-3} μm^3 *B is not correct because that is to an incorrect power of 10* *C is not correct because that is using the diameter* *D is not correct because that is using the diameter*	**(1)**

Question Number	Answer	Mark
6(c)(i)	The only correct answer is C 2 only *A is not correct because sperm cells contain half the DNA and starch does not release energy for sperm cell motility* *B is not correct because starch does not release energy for sperm cell motility* *D is not correct because starch does not release energy for sperm cell motility*	**(1)**

Question Number	Answer
*6(c)(ii)	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. • fertilised egg cells have a thinner zona pellucida (ZP) than unfertilised egg cells / converse • correct description of one piece of data from table • thicker the ZP then the lower the {probability / chance} of fertilisation / thicker ZP increases chance of infertility • relevant comment regarding {how egg cells are fertilised / sperm cell adaptation} • SD overlap so {there is not a significant difference / comparative conclusions are invalid} / relevant comment about size of SD linked to {reliability/validity} • some sperm cells may contain less {acrosin / enzyme for acrosome reaction} • problems digesting the zona pellucida with a lower {acrosin / enzyme} concentration • it takes longer for the enzyme to digest a thicker ZP / may not be sufficient enzyme to digest a thicker ZP / enzymes might not be able to digest all ZP • low sperm count could reduce the {probability / chance} of fertilisation • fewer egg cells are fertilised if there is a longer time period between ejaculation and fusing with egg cell membrane • a long time period could result in sperm {losing motility / not having enough energy / dying} • increase (probability / chance) of fertilisation using IVF (compared to non-IVF fertilisation) / injecting sperm would increase number of fertilised egg (cells) • sperm cells do not need to digest ZP if they are injected into egg cell / helps sperm cells {penetrate membrane / reach nucleus} • IVF technique can inject {non-motile / deformed / low acrosin} sperm cells into egg cell • consideration of {ethical issues / expense} from using IVF • consideration of possible increase in cancer risk from IVF hormones / risk of polyspermy / relevant comments regarding health risk

			(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 conclusion.	Limited conclusion covering at least one of the following: - the effect on mean ZP thickness from the table - the fertilisation process linked to thickness of {ZP / timescale} - effects of injecting sperm cells
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.	Conclusion covering at least two of the following: - the effect on mean ZP thickness from the table - the fertilisation process linked to thickness of {ZP / timescale} - effects of injecting sperm cells
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.	Conclusion covering at least three of the following: - the effect on mean ZP thickness from the table - the fertilisation process linked to thickness of {ZP / timescale} - effects of injecting sperm cells

Question Number	Answer	Additional guidance	Mark
7(a)(i)	An answer that makes reference to three of the following points: • as age increases the number of cases (of cancer in both sexes) increase (1) • (the number of cases in males continues to increase up to age 80) whereas the number of cases in females decreases {between 70 to 80 / after 79} (1) • males are more likely to get this cancer / converse for females (1) • conclusion as to why there is a difference between males and females (1)	accept more cases (of cancer) in older people accept there is a higher number of cases (of cancer) in all ages (after 30/ 39 / 40} accept this cancer is only found in people aged {over 39 / 40+} accept (males have greatest number after 80) whereas females have greatest between 70-79 (years) accept largest increase in cases is for males ages 60-69 accept more males have this cancer (than females) / converse e.g. idea that cancer allele could be on X chromosomes / inheritance (of this cancer) is sex-linked / other valid conclusion as to why males are more at risk e.g. hormone / lifestyle	**(3)**

Question Number	Answer	Additional guidance	Mark
7(a)(ii)	A calculation in which: • calculation of 3% of 2 million (1) • calculation of number of males with cancer (1)	<u>Example of calculation</u> (0.03 × 2 000 000) = 60 000 (60 000÷ 100 000) × 660 =396 no ecf correct answer scores full marks	**(2)**

Question Number	Answer	Additional guidance	Mark
7(b)(i)	• to allow the {chromosomes / chromatids} to be visible / in order to distinguish the phase of mitosis (1)	accept see which cells are in mitosis ignore to see which cells are dividing	**(1)**

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation that makes reference to the following points: • count the number of **cells** in mitosis (1) • divide by the total number of **cells** (in tissue sample and ×100) (1)	accept count number of cells with **visible** {chromosomes / chromatids} ignore count actively dividing cells	**(2)**

Question Number	Answer	Mark
7(c)(i)	The only correct answer is C prophase *A is not correct because chromosomes do not condense in anaphase* *B is not correct because chromosomes do not condense in metaphase* *D is not correct because chromosomes do not condense in telophase*	**(1)**

Question Number	Answer	Additional guidance	Mark
7(c)(ii)	An answer that makes reference to the following points: • preventing the condensing of chromosomes would {prevent mitosis occurring / reduce number of cells in mitosis / prevent prophase / prevent metaphase} (1) • (reduced number of cells in mitosis) would {reduce the / lead to a low} mitotic {rate / index} (1) • therefore patients with cancer have a higher percentage survival (1)	accept preventing the condensing of chromosomes will {reduce mitosis / mean cells remain in interphase} accept takes longer to form **cancer** cells / fewer **cancer** cells produced accept patients live longer / smaller decrease in percentage survival	**(3)**

Question Number	Answer	Mark
8(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
8(a)(ii)	An explanation that makes reference to the following points: • each population of island fox cannot mate with individuals on another island (1)	accept there is {geographical / reproductive} isolation / allopatric speciation accept they can't reproduce together accept foxes can only mate with foxes on their own island / no gene flow between islands ignore can't reproduce to form fertile offspring	**(4)**
	• (as each island has) **different** {(environmental) conditions / habitats / selection pressures} (1)	accept named conditions	
	• individual with advantageous **allele** will (survive and) {reproduce/pass onto offspring} (1)	accept natural selection occurs / change in allele frequency accept individuals without advantageous alleles will not survive accept inbreeding (depression) occurs / decrease in gene pool ignore gene	
	• (resulting in) populations being genetically **different** (to each other) / offspring on one island would be genetically **different** to offspring on a different island / accumulation of **different** genetic material results in new subspecies (1)	accept **different** {alleles / mutations} would be advantageous (on different islands) accept {**different** alleles will be {selected for / lost} / **different** change in allele frequency} (on different islands) accept (populations on different islands have) **different** gene pools ignore gene / speciation ignore change in allele frequency	

Question Number	Answer	Additional guidance	Mark
8(a)(iii)	An explanation that makes reference to the following points: • {comparison / analysis} of (the sequences in) named biological molecules / molecular phylogeny (1) • (therefore) the subspecies with the {**most** similarities / **fewest** differences} (are the most closely related to the Santa Cruz island fox) (1)	e.g. DNA, mRNA, proteins, alleles, base sequence / introns ignore bases unqualified accept comparison of banding pattern in gel electrophoresis / DNA profiling ignore more similar means more related	**(2)**

Question Number	Answer	Additional guidance	Mark
8(b)(i)	A calculation in which: • correct percentage change (1)	<u>Example of calculation</u> 1500 – 80 = 1420 (1420 ÷ 1500) × 100 =(-)94.67 / 94.7 / 95% accept 1994 values between 1500 to 1520 inclusive to give answer between 94.67 to 94.74 inclusive or rounded to 95(%) max 2 dp correct answer scores full marks	**(1)**

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	An explanation that makes reference to the following points: • calculate the allele frequency for {p / q} (in 1994) / calculate $p^2 + 2pq + q^2 = 1$} (in 2000) (1) • {compare this with / subtract} the {(allele) **frequency** / **p / q**) (in 1994) (to see if there has been a change) (1)	accept calculate the {dominant / recessive} allele frequency ignore calculate allele frequency unqualified (i.e. not linked to dominant/recessive/p/q/correct equation) accept calculate p+q=1 **reject** mp1 if an equation is incorrect	**(2)**

Question Number	Answer	Additional guidance	Mark
8(b)(iii)	An answer that makes reference to four of the following points: • establish protected areas / increase food source (1)	accept provide food / protect from predators (including humans) education of local population to protect {fox / fox habitat} ignore {establish / put in a} zoo	**(4)**
	• reduce the population of {**golden eagles / dogs / racoons**} (1)	ignore remove predators unqualified	
	• (reduce deaths from disease by) {treating diseased foxes (with medication) / vaccination} (1)	accept {eradicate / cure} disease ignore prevent disease transmission	
	• use of captive breeding programme (to increase population size) / reintroduce (captive bred) foxes (1)	accept breeding programme accept description of captive breeding programme accept artificial insemination / exchange of animals with different zoos ignore breeding with similar foxes / other fox populations (from different islands)	
	• {analysis of **genotype** of foxes used in captive breeding programme / use of stud books} to ensure genetic diversity of fox population is maintained (1)	accept select foxes with different **alleles** to mate together / prevent inbreeding	

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