

Mark Scheme (Results)

Summer 2019

Pearson Edexcel GCE
In Biology Spec B (9BI0) Paper 02
Advanced Physiology, Evolution and Ecology

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Summer 2019
Publications Code 9BI0_02_1906_MS
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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.
- In questions marked with an **asterisk** (*), marks will be awarded for the ability to structure answers logically showing how the points are related or follow on from each other where appropriate.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	UGG GGU UCC GAG		**1**

Question Number	Answer	Mark
1(a)(ii)	The only correct answer is A degenerate *B is incorrect because non-overlapping refers to discrete reading frames* *C is incorrect because it simply refers to three bases* *D is incorrect because it refers to the same code in all organisms*	**1**

Question Number	Answer	Mark
1(b)(i)	The only correct answer is A hydrogen only *B is incorrect because ionic bonds are not involved in the secondary structure* *C is incorrect because disulfide bonds are not involved in the secondary structure* *D is incorrect because ionic bonds are not involved in the secondary structure*	**1**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An explanation that makes reference to three of the following: • {tyrosinase active / melanin made} in cooler regions (1) • tyrosinase denatures / {hydrogen / ionic} bonds break (in warm / light regions) (1) • active site changes shape / tertiary structure changes (1) • no enzyme substrate complexes form / tyrosine does not bind (to tyrosinase / enzyme) (1)	**ACCEPT** converse throughout **ACCEPT** enzyme for tyrosinase for all mark points **ACCEPT** optimum temperature is cool / low	**3**

Question Number	Answer	Mark
2(a)(i)	The only correct answer is C sensory neurone and dorsal root *A is incorrect because X is a sensory neurone* *B is incorrect because X is a sensory neurone and Y is the dorsal root* *D is incorrect because Y is the dorsal root*	**1**

Question Number	Answer	Mark
2(a)(ii)	The only correct answer is D medulla oblongata *A is incorrect because the cerebellum does not control breathing and heart rate* *B is incorrect because the cerebrum does not control breathing and heart rate* *C is incorrect because the hypothalamus does not control breathing and heart rate*	**1**

Question Number	Answer	Additional Guidance	Mark
2(b)	An explanation that makes reference to four of the following: • sodium potassium pump (1) • therefore sodium (ions) move out and potassium (ions) move in (1) • potassium (ions) move out through potassium channels (1) • sodium channels close / membrane is impermeable to sodium (ions) / sodium (ions) do not move in (1) • outside more positive than inside (1)	**ACCEPT** Na^+ for sodium ions and K^+ for potassium ions **DO NOT ACCEPT** potassium channels are open so potassium ions enter **ACCEPT** only a few sodium channels are open / only a few sodium ions move in **ACCEPT** outside becomes positive **AND** inside becomes negative	**4**

Question Number	Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to four of the following: • change in {potential difference} in tetrodotoxin is small(er) / (1) • no action potential / less depolarisation (1) • (voltage gated) sodium channels {not open / closed / blocked} (1) • sodium (ions) cannot pass through membrane / sodium (ions) cannot enter neurone (1) • no nerve impulse to muscles / muscles not stimulated / muscles cannot contract (1)	**ACCEPT** no depolarisation **ACCEPT** less sodium ions enter **ACCEPT** effector for muscle	**4**

Question Number	Answer	Mark
3(a)	The only correct answer is B human immunodeficiency virus (HIV) *A is incorrect because Ebola virus does not have reverse transcriptase* *C is incorrect because lambda phage has DNA* *D is incorrect because tobacco mosaic virus does not contain reverse transcriptase*	**1**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	A description that makes reference to the following: • viral proteins / capsids made (1) • {viruses multiply / genetic material / RNA / DNA replicate} and {cells lyse / cells burst / viruses released from cell} (1)	**ACCEPT** viral RNA is translated	**2**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to two of the following: • virus {nucleic acid / RNA / DNA / genome} incorporated / integrated (into the host cell) (1) • virus is {dormant / inactive} (1) • virus nucleic acid replicates when host cell divides (1)	**ACCEPT** virus is not virulent **ACCEPT** viral RNA is not translated **ACCEPT** viral DNA is replicated when host cell DNA is replicated	**2**

Question Number	Answer	Additional Guidance	Mark
3(c)	An answer that makes reference to four of the following: • Zmapp is effective / more people survive when treated (1) • Zmapp has {little / no} effect up to {5/6} days /deaths rates are the same up to day {5/6} / Zmapp is effective after day {5/6} (1) • 3 doses / treatments are needed (1) • Zmapp side effects decrease over time (1) • sample size is {small / age unknown / sex unknown / trial only lasted nine days (1)	**ACCEPT** deaths with Zmapp level off at 28 **ACCEPT** no more deaths after 3 doses **ACCEPT** converse	**4**

Question Number	Answer	Additional Guidance	Mark
4(a)	AABB and AaBB and AABb and AaBb (in any order)		**1**

Question Number	Answer	Mark
4(b)	The only correct answer is D aaBb x aaBb *A is incorrect because the parents would be round and yellow* *B is incorrect because no yellow seeds could be produced* *C is incorrect because no yellow seeds could be produced*	**1**

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to the following: • parent genotypes are AaBb and aabb (1) • gametes are AB, Ab, aB, ab and ab (1) • F_1 genotypes are AaBb, Aabb, aaBb and aabb (1) • probability 0.25 / ¼ / 25% (1)	**ACCEPT** correct answers from Punnett square	**4**

Question Number	Answer	Mark
5(a)(i)	The only correct answer is A 1 and 2 *B is incorrect because photomorphogenesis is incorrect* *C is incorrect because photomorphogenesis is incorrect* *D is incorrect because photomorphogenesis is incorrect*	**1**

Question Number	Indicative content
5(b) *	Answers will be credited according to candidates' 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 which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content Level 1 Descriptions (D) • Sedum flowers with long period of light / short period of dark • Kalanchoe flowers with short period of light / long period of dark • Kalanchoe is a short day plant / Sedum is a long day plant • light during dark period means Sedum flowers / Kalanchoe does not flower • light then far red during dark period means Sedum does not flower / Kalanchoe flowers Level 2 Phytochrome (P) • phytochrome converted between P_R and P_{FR} • light converts P_R to P_{FR} • dark converts P_{FR} to P_R • far red converts P_{FR} to P_R • far red converts P_{FR} to P_R rapidly • short light exposure during dark period converts P_R to P_{FR} • Sedum needs (high) P_{FR} / (low) P_R to flower / Kalanchoe needs (high) P_R / (low) P_{FR} to flower Level 3 Explanation (E) • experiment 2 Kalanchoe should flower • experiment 2 Sedum should not flower but does because Kalanchoe produces florigen / growth factor / diffusible substance / FT mRNA • florigen / growth factor is transported between the two plants

	• florigen / growth factor activates genes • florigen / growth factor triggers flowering in both plants	
Level	**Marks**	
0	0	No awardable content
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information 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. **D only or P only**
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. **2 D and 1 P or 1 E**
3	5-6	An explanation is made which 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. **2 D, 2 P and 1E**

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	• correct calculation of N(N-1) • correct calculation of ∑n(n-1) • correct division of N(N-1) by ∑n(n-1) 1.5 (3)	<u>Example of calculation</u> = 3906 (1) = 2604 (1) 3906 ÷ 2604 = 1.5 Correct answer with no working gains full marks	**3**

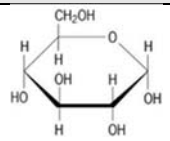
Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	An explanation that makes reference to the following: • index accounts for population / numbers of organisms (1) • because numbers of organisms in {each species vary} (1)	**ACCEPT** converse for both Mps **ACCEPT** population sizes can vary for two marks	**2**

Question Number	Answer	Additional Guidance	Mark
6(a)(iii)	An answer that makes reference to four of the following: **THREE from:** • birds are now {extinct / dead / none left} (on Guam) (1) • decrease in (bio)diversity (1) • Marian crow population increased until 1985 / Island collared dove increased until 1984 / white throated ground dove increased until 1983 /1984 (1) • bird species decline at different rates (1) **TWO from**: • loss of some bird species allowed others to increase / loss of some bird species provided niches / food for others (1) • snakes consumed some species before others (1)	**ACCEPT** other correct dates **ACCEPT** Species go extinct at different times **ACCEPT** reduced competition between birds (allows some bird species to increase) / reduced interspecies competition (allows some bird species to increase)	**4**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	An answer that makes reference to two of the following: • less distribution of seeds (1) • fewer {mineral / ions / fertiliser / nutrients} from faeces / excretion (1) • less predation / eating of insects (1) • less pollination / birds are pollinators (1)	**ACCEPT** less nutrient recycling **ACCEPT** not fertilised by faeces	**2**

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	A description that makes reference to four of the following: • variety of seeds from each {species / type} are kept / seeds from many {species / types / varieties} are kept / seeds with high genetic diversity are kept (1) • kept at {low / cold / frozen} temperature (1) • kept in {low humidity / low moisture / dry} (1) • kept in {airtight / sealed / low oxygen} containers (1) • seeds tested for viability / X-ray seeds to detect embryos / sterilise (1)	**ACCEPT** cryogenics	**4**

Question Number	Answer	Mark
7(a)(i)	The only correct answer is C hydrolysis reaction breaking glycosidic bonds *A is not correct because condensation reactions forms glycogen* *B is not correct because the bonds are not phosphodiester bonds* *D is not correct because the bonds are not phosphodiester bonds*	**1**

Question Number	Answer	Mark
7(a)(ii)	The only correct answer is A  *B is not correct because it is □-glucose* *C is nor correct because it is ribose* *D is not correct because it is deoxyribose*	**1**

Question Number	Answer	Additional Guidance	Mark
7(a)(iii)	An explanation that make reference to three of the following: • glucose molecules joined {1,4 glycosidic} bonds (1) • compact for (energy) storage (1) • {1,6 glycosidic bonds / branched} for rapid / easy {breakdown / hydrolysis} (1) • {large / insoluble} molecule which does not {affect osmosis / leave cells / solute potential / water potential} (1)	**DO NOT ACCEPT** beta glucose once	**3**

Question Number	Answer	Additional Guidance	Mark
7(b)	A description that makes reference to three of the following: • adrenaline binds to receptors on {membrane / cell (surface)} (1) • {second messengers / cAMP} involved / (1) • {activates / binds to / triggers to} glycogen phosphorylase / protein kinase (1) • {diffusion} of glucose (out of cells) (1)	**DO NOT ACCEPT** in cells **ACCEPT** adenylate cyclase activated **ACCEPT** glycogen phosphorylase is phosphorylated	**3**

Question Number	Answer	Additional Guidance	Mark
7(c)(i)	A calculation that makes reference to three of the following: • calculation of q^2 • calculation of p and q • calculation of 2pq • calculation of the number of heterozygotes in a population of 1400 252 to 260 (4)	<u>Example of calculation</u> 15 ÷ 1400 = 0.0107 p = 0.897 q = 0.103 2pq = 2 x 0.897 x 0.103 = 0.185 0.185 x 1400 = 259 Correct answer with no working gains full marks **ACCEPT** one mark for: q^2 = 0.01 to 0.0107 p = 0.897 to 0.9 **and** q = 0.1 to 0.103 **ACCEPT** 2pq = 0.18 to 0.187 in final answer for **3** marks	**4**

Question Number	Answer	Additional Guidance	Mark
7(c)(ii)	An explanation that makes reference to two of the following: • founder effect (1) • therefore genetic bottleneck / therefore small gene pool (1) • more likely to receive two recessive alleles (from parents) / both parents are more likely to be heterozygous / carriers (1)	**ACCEPT** low genetic diversity / small number of different alleles	**2**

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	An answer that makes reference to the following: • (interactions) of {organisms / biotic factors / communities / living} and {environment / abiotic factors / non-living factors} (1)	**IGNORE** habitat / area	**1**

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	An explanation that makes reference to five of the following: • colonisation (of bare rock) by pioneer species / extremophiles / by organisms that withstand {low water / dry / low soil} (1) • (primary) succession occurs (1) • soil / humus produced (1) • therefore provides {water / minerals / nutrients / anchorage} for plants to grow (1) • provides niches / food / habitats for animals (1) • herbaceous plants / shrubs / trees become established / climax community emerging (1)	**ACCEPT** founder	**5**

Question Number	Answer	Additional Guidance	Mark
8(b)	An answer that makes reference to four of the following: • increase in number of species in 1974 **and** increase in number of species after 1985 / 1989 (1) • no increase in number of species between 1978 and 1985 (1) • birds bring seeds (1) • birds release {waste / faeces / organic waste} containing minerals (1) • seagulls reduce number of herbivores / create new niches (1)	**ACCEPT** Number of species increases after both seagull species arrive	**4**

Question Number	Answer	Mark
9(a)(i)	The only correct answer is C hydrogen *A is incorrect because covalent bonds do not form between neighbouring water molecules* *B is incorrect because ionic bonds to not form between neighbouring water molecules* *D is not correct because hydrophobic bonds do not form between neighbouring water molecules*	**1**

Question Number	Answer	Mark
9(a)(ii)	The only correct answer is C three *A is incorrect because there are three components* *B is incorrect because there are three components* *D is incorrect because amino acids are not a component*	**1**

Question Number	Answer	Additional Guidance	Mark
9(b)(i)	• data correctly substituted into equation 14 / 14.1 / 14.07	<u>Example of calculation</u> (67 x 0.21 =) 14	**1**

Question Number	Answer	Additional Guidance	Mark
9(b)(ii)	An explanation that makes reference to four of the following: • less oxygen in blood / capillaries / lower partial pressure of oxygen in blood (1) • because alveoli have less surface area (1) • because (lack of surfactant) prevents expansion (1) • less air / oxygen inhaled (1)	**ACCEPT** more likely to collapse	**4**

Question Number	Indicative content
9(c)*	Answers will be credited according to candidates' 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 which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content Descriptions (D) • A, B increase Carrico index / alveolar expansion • A and B together gives the highest level of improvement in Carrico index / more than natural surfactant • Both compounds A and B together are best to treat ARDS / increase the Carrico index • A alone is least effective • B increases Carrico index more than A • in all cases, the improvement is rapid and persists from 30 to 120 minutes Analysis (A) • valid comparison with natural surfactant / control • B has similar increase in Carrico index as natural surfactant / control • A has lower increase compared to natural surfactant / control • positive correlation between alveoli expansion and Carrico index • improving alveoli expansion results in improvement in blood oxygenation which improves Carrico index • the artificial surfactants allow alveoli to expand, increasing surface area and oxygen diffusion into blood • unaffected baby has index of 67 which is what A and B reach Potential use (P)

	• rabbits may not respond in the same way as humans to the compounds • may not be safe in humans • small sample size • no comparison has been made with no surfactant	
Level	**Marks**	
0	0	No awardable content
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information 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 **Only D**
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. **D + A or D+ P**
3	5-6	An explanation is made which 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. **D+A+P**

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