

Mark Scheme (Results)

Summer 2024

Pearson Edexcel GCE
In Biology B (9BI0/02)
Paper 2: Advanced Physiology, Evolution and Ecology

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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)(i)	The only correct answer is D (S) *A is incorrect as P is the nucleus* *B is incorrect as Q is a mitochondrion* *C is incorrect as R is rER*	**(1)**

Question Number	Answer	Mark
1(a)(ii)	The only correct answer is C (R) *A is incorrect as translation does not occur in P* *B is incorrect as translation does not occur in Q* *D is incorrect as translation does not occur in S*	**(1)**

Question Number	Answer	Mark
1(a)(iii)	The only correct answer is A (0) *B is incorrect as none of the structures are present in Archaea* *C is incorrect as none of the structures are present in Archaea* *D is incorrect as none of the structures are present in Archaea*	**(1)**

Question Number	Answer	Additional guidance	Mark
1(b)	• correct calculation of magnification (1) • answer given in standard form (1)	**one mark** for answer between 1361 up to 1417 Correct answer but with wrong standard for e.g. between 13.6×10^2 up to 14×10^2 = **one mark** **two marks** for answer between 1.36×10^3 up to 1.42×10^3 **(2)** **Accept** any number of decimal places **Correct answer gains both marks**	**(2)**

Question Number	Answer	Additional guidance	Mark
1(c)	An explanation that makes reference to two of the following: • to <u>prevent</u> enzyme and substrate reacting / do <u>not</u> form E-S complexes / hydrogen cyanide <u>is not</u> produced (1) • react when {cell damaged / vacuole and chloroplast break} / so dhurrin and glucosidase only come into contact when cell is {eaten / damaged} (1) • so plant (cell) does not die / stop growing (1)	**Accept** <u>stop</u> dhurrin and glucosidase reacting **Accept** <u>if together</u> would produce hydrogen cyanide	**(2)**

(Total for Question 1 = 7 marks)

Question Number	Answer	Additional guidance	Mark
2(a)(i)	A description that makes reference to the following: • (megaspore mother cell) meiosis producing <u>four</u> {haploid / n} {<u>nuclei / megaspores</u>} (1) • three (nuclei / megaspores) disintegrate / disappear (1) • only one (nucleus / megaspore) then undergoes mitosis (1) • <u>three</u> (mitotic) divisions occur (to produce 8 nuclei) (1)	penalise cells **once** e.g. meiosis makes four haploid cells but three cells disintegrate = one mark Award marks from correct labelled diagrams	**(3)**

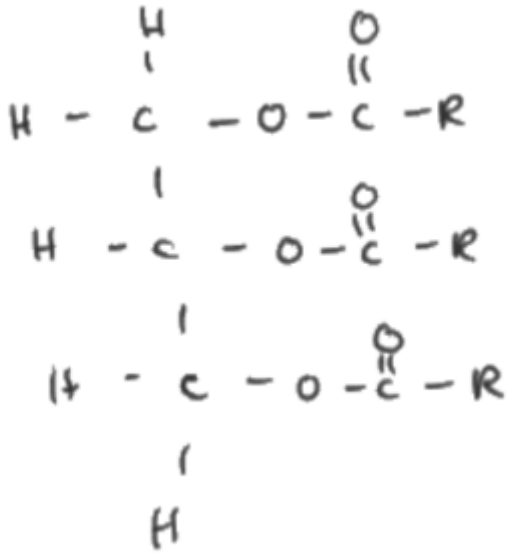
Question Number	Answer	Mark
2(a)(ii)	The only correct answer is C *A is incorrect as endosperm cells are 3n* *B is incorrect as endosperm cells are 3n* *D is incorrect as embryo cells are 2n*	**(1)**

Question Number	Answer	Mark
2(b)	The only correct answer is C (gibberellin) *A is incorrect as auxin does not stimulate enzyme production* *B is incorrect as cytokinin does not stimulate enzyme production* *D is incorrect as phytochrome does not stimulate enzyme production*	**(1)**

Question Number	Answer	Mark
2(c)(i)	The only correct answer is D (rrTt and rrTT) *A is incorrect as RrTT is red* *B is incorrect as rrTT is also yellow* *C is incorrect as rrtt is white*	**(1)**

Question Number	Answer	Additional guidance	Mark
2(c)(ii)	An answer that makes reference to the following: • correct parent genotypes (rrTt, RrTt) (1) • correct gametes (rT, rt **AND** RT, Rt, rT, rt) (1) • correct genotypes of offspring (RrTT, RrTt, Rrtt, rrTT, rrTt, rrtt) (1) • correct ratios of phenotypes (4 red : 3 yellow : 1 white **OR** 8 red : 6 yellow : 2 white) (1)	**Allow ECF** for mp2 **ONLY** if wrong parental genotypes have been stated (max 1) **Allow** mp1,2,3 from Punnet square The **three** phenotype colours must be shown somewhere for mp4	**(4)**

(Total for Question 2 = 10 marks)

Question Number	Answer	Additional guidance	Mark
3(a)(i)	 (1)		**(1)**

Question Number	Answer	Mark
3(a)(ii)	The only correct answer is A (condensation releasing water) *B is incorrect as water is not used* *C is incorrect as the reaction is not hydrolysis* *D is incorrect as the reaction is not hydrolysis*	**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)(i)	19		**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	An answer that makes reference to the following: • both contain COOH / both contain the elements {C, H, O} / both have carbon-hydrogen bonds / C-C bonds / carbon to carbon **single** bonds / same number of oxygens / both have an OH group (1) • saturated fatty acids have {no carbon-carbon double bonds / C=C bonds} / saturated fatty acids have higher proportion of hydrogen atoms / saturated are {straight / not kinked} (1)	**Accept** both have carboxylic acid (groups) **Allow** converse for unsaturated	**(2)**

Question Number	Answer	Additional guidance	Mark
3(b)(iii)	An answer that makes reference to three of the following: • {palmitic / stearic} is saturated / {oleic / linoleic / linolenic} is unsaturated (1) • {almond / flaxseed} has high unsaturated / {cocoa butter} has high saturated / {almond / flaxseed} has less low saturated / {cocoa butter} has low unsaturated (1) • {almond / flaxseed / unsaturated fatty acids} {do not increase CHD / less likely to lead to atherosclerosis / fewer plaque deposits in artery} (1) • {almond / flaxseed / unsaturated fatty acids} has less energy so less obesity (1)	**Accept** palmitic or stearic as equivalent to saturated e.g. {palmitic acid / stearic acid} are high in cocoa butter for **mp 2, 3, 4** **Accept** oleic or linoleic or linolenic for unsaturated fatty acids e.g. oleic acid is high in almond oil for **mp 2, 3, 4** **Accept** converse for saturated / cocoa **Accept** correct ref to LDLs / HDLs **Accept** converse for saturated / cocoa	**(3)**

(Total for Question 3 = 8 marks)

Question Number	Answer	Additional guidance	Mark
4 (a)	An explanation that makes reference to three of the following: • {thin epithelium / capillary endothelium / single cell thick} for short diffusion path (1) • {capillaries / good blood supply} to maintain {diffusion / concentration} <u>gradient</u> (1) • {many alveoli / shape of alveoli} increases surface area for high (rate of) {diffusion / gas exchange} (1) • {fluid / water / moisture} to dissolve gases (1)	**Do not accept** <u>cell</u> walls **Accept** thin lining **Accept** thin wall **Accept** thin membrane	**(3)**

Question Number	Answer	Mark
4(b)	The only correct answer is **B** (1 and 3) *A is incorrect as adrenaline does not bind to transcription factors* *C is incorrect as adrenaline does not bind to transcription factors* *D is incorrect as adrenaline does not bind to transcription factors*	**(1)**

Question Number	Answer	Additional guidance	Mark
4(c)(i)	• correct tangent to the curve at 1 s (1) • division of volume by time (1)	**Accept** correct tangent **and** range between 0.7 to 0.9 for 2 marks	**(2)**

Question Number	Answer	Additional guidance	Mark
4 (c)(ii)	An explanation that makes reference to the following: • {exhalation / inhalation / ventilation} is more rapid / more air breathed {in / out} (in same time) (1) • to maintain a {diffusion / concentration} gradient (1) • so {fast / high / more} <u>diffusion</u> of oxygen into {blood / capillaries} (1)	**Accept** higher tidal volume **Accept** oxygen for air **Accept** maintains high <u>partial pressure</u> of oxygen in <u>alveoli</u> / high oxygen <u>concentration</u> in <u>alveoli</u> **Accept** steep diffusion gradient enables rapid movement into blood = mp2 and mp3	**(3)**

(Total for Question 4 = 9 marks)

Question Number	Indicative content	Mark
5 *(a)	Answers will be credited according to candidate's deployment of knowledge and understanding of 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. **Descriptions of Forest fires (F) (Graph 1)** • there is an increase in number of fires over time • but there is decrease in last few years • there are some years that do not fit the trend / fluctuations **Descriptions of changes in vegetation (S) (Graph 2)** • herbaceous plants decrease over time / are high after fires • species number decreases with age of forest • number of different species of all types decrease at 40 years • number of all species increases up to 7 years then decreases • (secondary) succession occurs after forest fires • (secondary succession) is due to presence of seeds / roots • many annual species at start that then decrease • after 40 years, climax community has developed • fewer species at climax community / dominated by a few species **Discussion ideas (D)** • forest fires may be due to other factors / human activity / forest fires may be natural events • climate change would dry out the forests so fires are more likely • no clear link between forest fires and climate change in the data – idea of correlation not causal • the carbon dioxide from fires will lead to more global warming / climate change • forest fires increase species diversity / are away of increasing species diversity / older forest is less diverse • idea that early stages in succession are more productive / remove more carbon • older woody trees shade the ground (reducing productivity) • older forests will have fewer niches • fires may reduce animal diversity / may affect other species, e.g. nesting sites / less food for animals / loss of habitat • other measures to reduce carbon emissions may be more effective • preventing forest fires may harm herbaceous plants / smaller plant species • the data is only about Europe / Europe has fewer forests / small sample size idea / European forests are not representative	**(6)**

Level 0	Marks	No awardable content
Level 1	1-2 (1-3)	Limited scientific judgement made with a focus on mainly just one method, 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. **1 mark (any one points from F, S, D)** **2 mark (any two points from F, S, D)**
Level 2	3-4 (4-6)	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made. **3 marks (at least three from any two of F, S, D)** **4 marks (at least four from any two of F, S, D)**
Level 3	5-6 (7-9)	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. **5 marks (at least four from all of F, S and D)** **6 marks (at least five from all of F, S and D)**

Question Number	Answer	Additional guidance	Mark
5(b)(i)	• Calculation of N(N-1) (1) • Calculation of $\sum n(n-1)$ (1) • Calculation of Index of biodiversity (1)	Example of calculation: 130 x 129 3580 4.68 130 x 129 **OR** 16770 **OR** 130 (130-1) **(one mark)** 3580 **(one mark)** 4.68 **(3 marks)** **Correct answer gains all three marks**	**(3)**

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that makes reference to the following: • takes population numbers into account / takes account of abundance (1)	**Accept** species evenness **Accept** populations may change / the number of individuals of each species may change	**(1)**

Question Number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that makes reference to two of the following: • there are many food chains / food webs are complex (1) • because there are alternative food sources (1) • there are different predators (1) • range of niches / many habitats (1) • there is {high genetic diversity / many alleles / large gene pool} **and** some {survive / have advantageous alleles} (1)	**Ignore** lots of food **Accept** many food sources / different prey / **Accept** different niches **Accept** many alleles **and** some (advantageous) alleles) are passed on	**(2)**

(Total for Question 5= 12 marks)

Question Number	Answer	Additional guidance	Mark
6(a)	An explanation that makes reference to three of the following: • the curve is {S-shaped / sigmoidal} (1) • because cooperative binding occurs (1) • when the first (molecule of) oxygen binds, the shape of subunits change / (1) • so (subsequent) oxygen molecules bind more easily / affinity increases as more oxygen binds (1) • oxygen binds when blood is in {alveoli / lungs} **and** oxygen is released in {tissues / muscles} (1)	**Accept** change shape (of haemoglobin) / conformational change / allosteric change occurs	**(3)**

Question Number	Answer	Additional guidance	Mark
6(b)	An explanation that makes reference to three of the following: • the haemoglobin is (already) saturated at 14 kPa (so adding more oxygen has no effect) (1) • **drug** does not affect oxygen saturation at {14 kPa / high partial pressures} (1) • drug shifts curve to right (1) • drug reduces the affinity (for oxygen at lower partial pressures) (1) • so more oxygen is {released / unloaded / dissociated} to tissues (1)	**Accept** Hb saturated at 12 kPa / increasing oxygen will not enable any more oxygen to bind **Accept** with drug saturation is similar (to without drug) at high partial pressures **Accept** has effect like Bohr shift	**(3)**

(Total for Question 6 = 6 marks)

Question Number	Answer	Mark
7(a)	The only correct answer is C *A is incorrect as it is the medulla* *B is incorrect as it is the pituitary gland* *D is incorrect as it is the cerebellum*	**(1)**

Question Number	Answer	Additional guidance	Mark
7(b) (i)	An explanation that makes reference to four of the following: • {muscle contraction / respiration} releases heat (energy) (1) • core temperature does not rise as much as skin temperature (1) • (blood) temperature rise detected by {hypothalamus / thermoregulatory centre} / impulses from {hypothalamus / thermoregulatory centre} to {skin / sweat glands / shunt vessels} (1) • vasodilation causes {skin temperature to rise / skin to heat up} (1) • <u>water</u> from sweat <u>evaporates</u> (1) • {evaporation / radiation} {removes heat / cools skin} so (skin temperature rise levels off / prevents further increase (1)	**Accept** exothermic reactions Can piece together **Accept** increased blood flow to skin increases (skin) temperature **Ignore** vasodilation of veins / capillaries	**(4)**

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	• an example of behavioural thermoregulation	**Allow** correct examples of behaviour e.g. pressing body down onto hot sand or seek shade in hot conditions Candidates may answer this in a variety of ways	**(1)**

Question Number	Answer	Additional guidance	Mark
7(b)(iii)	An explanation that makes reference to the following: • if the body cools (positive feedback) makes it even colder / when temperature drops it causes a larger temperature drop (1) • because respiration is slower / enzymes have less (kinetic) <u>energy</u> / metabolism is slower / exothermic reactions are slower (1) • (respiration / metabolism / exothermic reactions) release (even) less heat (energy) (1)	**Accept** idea that (positive feedback) is when a change in conditions causes a further change away from the normal	**(2)**

Question Number	Answer	Additional guidance	Mark
7(c)	A description that makes reference to three of the following: • {high blood salt concentration / low blood water potential} stimulates osmoreceptors (in hypothalamus) (1) • causing ADH release from <u>pituitary</u> (1) • ADH causes increase in permeability of collecting duct / ADH causes more aquaporins in membranes of collecting duct (cells) (1) • more (re)absorption of water into <u>blood</u> (1)	**Accept** low blood water concentration **Accept** from hypothalamus **Accept** more water goes into <u>blood</u>	**(3)**

(Total for Question 7= 11 marks)

Question Number	Answer	Mark
8(a)	The only correct answer is B (motor neurone in the ventral root) *A is incorrect as motor neurones are not in the dorsal root* *C is incorrect as it is not a sensory neurone* *D is incorrect as it is not a sensory neurone*	**(1)**

Question Number	Answer	Additional guidance	Mark
8(b)(i)	• correct reading of speed from graph (1) • correct calculation of distance (1)	68 x 0.4 = 27.2 m **Accept** answers between 27.2 up to 28.0 for **2 marks** **Accept** number between 68 and 70 in working for **one mark** **Accept** between 27200 and 28000 for **one mark** **Correct answer gains both marks**	**(2)**

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	An explanation that makes reference to two of the following: • impulses travel more slowly / longer time for impulse to travel (1) • less saltatory (conduction) (1) • impulses cannot jump between nodes of Ranvier (1)	**Accept** converse for when myelin present for all mps **Accept** there are fewer / no nodes of Ranvier **Accept** impulse must travel along all parts of neurone membrane (because there are no nodes)	**(2)**

Question Number	Answer	Mark
8(c)(i)	The only correct answer is C *A is incorrect as ionic bonds also make the tertiary structure* *B is incorrect as hydrogen bonds also make the tertiary structure* *D is incorrect as peptide bonds do not make the tertiary structure*	**(1)**

Question Number	Answer	Additional guidance	Mark
8(c)(ii)	A description that makes reference to four of the following: • calcium channels open **and** calcium (ions) enters neurone (1) • vesicles {fuse with (presynaptic) membrane / undergo exocytosis} releasing neurotransmitter (1) • <u>neurotransmitter</u> binds to receptors on <u>post synaptic</u> (membrane / neurone)(1) • chloride (ions) enter the neurone (1) • membrane hyperpolarises / becomes less positive outside / more negative inside membrane (1)	**Accept** Ca^{2+} **Do not accept** Ca^{+} **or** Ca **Accept** correct named neurotransmitter e.g. glutamate **Accept** <u>neurotransmitter</u> moves across {cleft / gap} and binds receptors **Accept** potassium ions move out **Accept** membrane potential is further from threshold value	**(4)**

Question Number	Answer	Additional guidance	Mark
8(c)(iii)	An explanation that makes reference to three of the following: • fewer calcium (ions) enter neurone / membrane is less permeable to calcium (ions) / calcium (ions) do not increase inside neurone (1) • toxin blocks / inhibits / binds to <u>calcium channels</u> (1) • no neurotransmitter is released / no neurotransmitter can diffuse (across synapse) (1) • no {action potential / depolarisation} in post synaptic neurone / muscles cannot <u>contract</u> (1)	**Do not accept** calcium (ions) are reduced **Accept** prevents opening **Accept** correct named neurotransmitter e.g. acetylcholine	**(3)**

(Total for Question 8= 13 marks)

Question Number	Answer	Additional guidance	Mark
9(a)(i)	An explanation that makes reference to two of the following: • a founder effect has occurred (1) • so only a small range of <u>alleles</u> / small gene pool / low <u>genetic</u> diversity / low <u>genetic</u> variation (1) • high chance that two (harmful) recessive alleles will be inherited / high chance both parents carry (harmful) recessive allele (1)	**Accept** bottleneck **Do not accept** small number of genes **Accept** high chance both parents are heterozygous (and have harmful alleles)	**(2)**

Question Number	Answer	Additional guidance	Mark
9(a)(ii)	• p calculated (1) • 2pq calculated (1)	0.7 0.42 or 42 % **(two marks)** **One mark** for 0.7 in the working **Correct answer gains both marks**	**(2)**

Question Number	Answer	Additional guidance	Mark
9(a)(iii)	An answer that makes reference to two of the following: • no migration (1) • no sexual selection / natural selection (1) • no genetic drift / large population (1) • no mutation (1) • random mating / mixing (1)	 **Accept** none leave population / none enter population **Accept** isolated population **Accept** no selection pressure	**(2)**

Question Number	Answer	Additional guidance	Mark
9(a)(iv)	A description that makes reference to two of the following: • ban on movement of lions (between countries) / ban on trade / control of trade (1) • by countries that {sign / agree} the treaties (1) • ban on {poaching / killing / hunting} of animals (1)		**(2)**

Question Number	Indicative content
***9(b)**	Answers will be credited according to candidate's deployment of knowledge and understanding of 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. **Descriptions of graphs (G)** • all types of animals have more endangered species than threatened (G1) • more mammals / birds kept than invertebrates / amphibia (G1) • not that much difference between number of threatened an endangered amphibia / big difference between threatened and endangered for mammals / birds (G1) • zoos carry out research on many {mammals / birds} / little research on invertebrates (G2) • zoos support large amounts of in situ conservation for all species (G2) • high proportion of invertebrates have in situ conservation (G2) • ex situ conservation is low for {mammals / birds} / relatively high for amphibia (G2) **Knowledge (K)** • ex-situ conservation is keeping animals in zoos / in situ is keeping animals in habitats • zoos help prevent extinction of species / protect from poachers / predation ***ex-situ*** • leads to inbreeding / behaviour changes / ethical issues / unnatural environment • develops breeding programmes for release / allows scientific research / educational work • breeding programmes / stud books etc reduce genetic problems • modern zoos have enriched environments / more natural environments ***in-situ*** • expensive / may conflict with local people • also helps other species / habitats **Discussion points (D)** • some of the species in the zoos are just kept as exhibits rather than for conservation • the zoos raise money / awareness / research for in situ conservation / protect animals in habitats

	• fewer invertebrates in the zoos are kept for 'exhibits' (as less popular with visitors) / most are kept for conservation • more conservation of invertebrates / amphibia could be carried out • clear statement that some of the ethical issues of zoos are outweighed by benefits for some species • more research / raising of awareness could done on amphibia / invertebrates • difficult to make conclusion as no information about exact species / invertebrate grouping is very large • no information about the number / type of zoos assessed • only looks at numbers of threatened and endangered species / needs other categories / needs to include other groups e.g. fish / reptiles

	Marks	AO2 discuss
0	0	No awardable content
1	1-2 (1-3)	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. **1 mark: any two comments from any of G, K, D** **2 marks: any three comments from any of G, K, D**
2	3-4 (4-6)	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: any four comments from at least two of G, K, or D** **4 marks: any five comments from at least two of G, K, or D**
3	5-6 (7-9)	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. **5 marks: any five comments and must be from G, K, and D** **6 marks: any six comments and must be from G, K, and D must have considered both graphs**

(Total for Question 9= 14 marks)

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