

Mark Scheme (Results)

October 2020

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.

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.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	C *Turner's syndrome due to monosomy* *A is incorrect because there are not three copies of chromosome number 21* *B is incorrect because there are not three copies of chromosome number 21* *D is incorrect because Turner's syndrome is a monosomy*		**1**

Question Number	Answer	Additional Guidance	Mark
1 (a)(ii)	C non-disjunction *A because it is not a gene mutation* *B is incorrect because it is not a gene mutation* *D because there is a missing chromosome is incorrect*		**1**

Question Number	Answer	Additional Guidance	Mark
1 (b) (i)	A ☒ **A** anaphase | telophase | prophase | metaphase *B is incorrect because X is not prophase* *C is incorrect because W is not prophase* *D is incorrect because W is not telophase*		**1**

Question Number	Answer	Additional Guidance	Mark
1 (b) (ii)	An answer that makes reference to four of the following: • colchicine has no effect on the percentage of cells in interphase (1) • colchicine arrests cells at prophase (1) • colchicine inhibits spindle (formation) (1) • fewer cells reach {metaphase / anaphase / telophase} with colchicine / more cells reach {metaphase / anaphase / telophase} without colchicine / more cells at prophase with colchicine /fewer cells at all phases except prophase (1) • correct reference to overlapping of standard deviations (1)	**Accept** colchicine stops (many) cells at prophase / cells can only reach prophase with colchicine **Accept** converse **Accept** converse	**4**

Question Number	Answer	Additional Guidance	Mark
2 (a)	A description that makes reference to four of the following: • {action potential / impulse} arrives at (presynaptic) terminal / membrane / synaptic knob (1) • calcium channels open (1) • calcium ions diffuse into the neurone (1) • vesicles move towards the (presynaptic) membrane (1) • vesicles fuse with presynaptic membrane / exocytosis occurs (1)		**4**

Question Number	Answer	Additional Guidance	Mark
2 (b)(i)	An explanation that makes reference to the following: • {charge / shape} of active site changes (1) • so acetylcholine will not bind / can no longer form E/S complex (1)		**2**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	An explanation that makes reference to three of the following: • acetylcholine (from parasympathetic neurone) is not broken down / builds up in synaptic cleft (1) • so continues to bind to (acetylcholine) <u>receptors</u> (in SA node) (1) • so fewer impulses from SA node (1) • and noradrenaline has no / less effect (1)	**Accept** fewer depolarisations from SA node	**3**

Question Number	Answer	Additional Guidance	Mark
3 (a)	An explanation that makes reference to the following: • large numbers of mitochondria (1) • to provide ATP for active uptake of {glucose / salts / amino acids} (1) • microvilli providing large surface area (1) • for many carrier proteins for {glucose / salts / amino acids} (1)	**Accept** correct named minerals	**4**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	B ☒ **B** 1 and 3 *A is incorrect because facilitated diffusion does not move substances against a gradient* *C is incorrect because facilitated diffusion does not move substances between phospholipids* *D is incorrect because facilitated diffusion does not move substances against a gradient*		**1**

Question Number	Answer	Additional Guidance	Mark
3 (b)(ii)	C increased permeability of the collecting duct to water, producing more concentrated urine *A is incorrect because ADH increases the permeability of the collecting duct* *B is incorrect because ADH increases the permeability of the collecting duct* *D is incorrect because ADH results in more concentrated urine*		**1**

Question Number	Answer	Additional Guidance	Mark
4 (a)	An explanation that makes reference to the following: • in cross 3 V 4 both parents must be {carriers / heterozygous} (1) • to produce individual {8 /9 / offspring with long fur / offspring with long and short fur} (1)	**Accept** In cross 1 v 2 parent 2 must be heterozygous **Accept** To produce individual 6 / cat with long fur	**2**

Question Number	Answer	Additional Guidance	Mark
4 (b)(i)	X^BY FF and X^BY Ff	**Accept** alleles in any combination	**1**

Question Number	Answer	Additional Guidance	Mark
4 (b)(ii)	An explanation that makes reference to following: • male cats only have one X chromosome / female cats have two X chromosomes (1) • so can have {X^B and X^o / both fur colour alleles} (1)	**Accept** males only have one fur colour allele / only X^B or X^O	**2**

Question Number	Answer	Additional Guidance	Mark
4 (b)(iii)	An answer that makes reference to the following: • correct parental genotypes X^BX^o ff x X^oYFf • correct gametes X^Bf, X^of and X^oF and X^of, (X^oF), YF, Yf • correct F_1 • correct probability (0.125/12.5% / $^1/_8$)	**ECF** for mp 3 only	**4**

Question Number	Answer	Additional Guidance	Mark
5(a)	An answer that makes reference to the following: • correct structure of glycerol (1) • correct structure of three fatty acids (1)	Max one mark if other molecules e.g. water added to right hand side **Accept** 3 x one fatty acid	**2**

Question Number	Answer	Additional Guidance	Mark
5 (b)(i)	C 3 *A is incorrect because palmitic, myristic and stearic acid are saturated fats* *B is incorrect because palmitic, myristic and stearic acid are saturated fats*		**1**

	D is incorrect because palmitic, myristic and stearic acid are saturated fats		

Question Number	Answer	Additional Guidance	Mark
5 (b)(ii)	An answer that makes reference to four from the following: • %SFC for both decreases as temperature increases for both cocoa butter and palm oil / both have 5% SFC at 35 °C (1) • the % SFC of cocoa butter is higher at all temperatures (except 35 °C) (1) • because cocoa butter has higher percentage of / more saturated fat (1) • so fatty acid chains can associate with each other more easily (1) • the % SFC of cocoa butter decreases more steeply above 25 °C / larger decrease after 25°C (1)	**Accept** converse **Accept** converse **Accept** pack more tightly together / has straight chains/rods which pack tightly together higher density of intermolecular contacts/bonds	**4**

Question Number	Answer	Additional Guidance	Mark
5 (c) (i)	An explanation that makes reference to two from the following: • a genetic bottleneck has occurred (1) • resulting in a smaller gene pool (1) • so the probability of receiving two recessive alleles is higher (1)	**Accept** lower genetic diversity **Accept** inbreeding / higher chance of two organisms have similar alleles	**2**

Question Number	Answer	Additional Guidance	Mark
5 (c)(ii)	An explanation that makes reference to three from the following: • therefore animals from different populations can move across territories / forest to forest (1) • therefore increasing genetic diversity / widens gene pool / increased allele number (1) • and balances the needs of local people with conservation / retains jobs for local people (1) • local people are more likely to maintain the bridges (1)	**Accept** animals from different forests can move in / more outbreeding	**3**

Question Number	Answer	Additional Guidance	Mark
5(c)(iii)	An answer that makes reference to one from the following: • {banning export / import trade of species} preventing {poaching / illegal trapping} (1)	**Accept** {countries} sign treaty / agree preventing {poaching / trapping / exports / imports / trade}	**1**

Question Number	Answer	Additional Guidance	Mark
6 (a)	**B** 0.75 ms A is incorrect because at 0.5s it is a resting potential C is incorrect because sodium channels are closed D is incorrect because sodium channels are closed		**1**

Question Number	Answer	Additional Guidance	Mark
6 (b)(i)	An answer that makes reference to four from the following: similarity • same speed at 1 μm • speed increases for myelinated and unmyelinated axons (1) differences (max 3) • for axon diameters of more than 1 μm, myelinated are faster (1) • myelinated have a steeper / greater increase (1) • myelinated axons are slower below 1 μm in diameter (1) • myelinated is linear relationship	At least one similarity and one difference **Accept** converse **Accept** ref to numerical comparison **Accept** converse **Accept** proportional increase / **Accept** converse for non-myelinated	**4**

Question Number	Answer	Additional Guidance	Mark
6 (b)(ii)	• correct extrapolation to y axis to calculate c (1) • correct calculation of gradient • correct calculation of speed at 5 μm diameter (1)	-0.5 (**Accept** -0.4 to -0.6) 2/0.8 = 2.5 12 m s^{-1} (**Accept** between 11.9 and 12.1) **Accept** 12 for two marks Correct answer gains full marks	**3**

Question Number	Answer	Additional Guidance	Mark
6 (b)(iii)	An explanation that makes reference to three of the following: • saltatory transmission does not occur (1) • because there are {fewer / no} nodes of Ranvier (1) • so impulse does not jump (between nodes) (1) • and sodium channels have to stimulate local current flow along each section of membrane / sodium channels have to open in every part of membrane / depolarisation has to occur along the whole length (1)		**3**

Question Number	Answer	Additional Guidance	Mark
7 (a)	A is correct *apoplastic pathway* *B is incorrect as this is an incorrect term* *C is incorrect as the water passes through cell walls* *D is incorrect as the water passes through cell walls*		**1**

Question Number	Answer	Additional Guidance	Mark
7 (b)	An answer that makes reference to four from the following: • sugars are loaded / pumped / transferred into phloem / sieve tubes in leaf (1) • lowering water potential so that water enters phloem (1) • pressure in phloem increases (moving sugars) (1) • sugars are converted to (insoluble) starch in root cells / low sugar concentration in root cells (1) • increasing the water potential, so water moves out (1)		**4**

Question Number	Indicative content
7 (c)*	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. • mistletoe lowers the NPP of apple trees over time (D) • NPP of trees without mistletoe shows an upward trend over 20 years (D) • NPP of trees with mistletoe shows an downward trend over 20 years (D) • mistletoe decreases the transpiration rate of the trees (D) • mistletoe has a higher transpiration rate than the apple tree (D) • higher transpiration rate of mistletoe diverts transpiration stream to mistletoe rather than apple tree / mistletoe takes the water from apple tree (E) • so less minerals are given to the apple tree (E) • less water for photosynthesis (E) • nitrogen content of apple trees is lower (D) • less amino acid / protein synthesis occurs (E) • less enzyme production so less photosynthesis (E) • lowering NPP (due to less enzymes) (E) • less nucleic acid synthesis (E) • less chlorophyll synthesis (E) • calcium content of the apple trees is lower (D) • so there is less production of cell walls / calcium pectate (E)

	Level 1: one or two D or E **Level 2: three or four from both D and E** **Level 3: five or six from both D and E, must explain effect of either low nitrogen / calcium and have no major errors**

Level	**Marks**	
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.
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.
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.

Question Number	Answer	Additional Guidance	Mark
8 (a)(i)	• correct value from graph (1) • correct calculation of oxygen in 1 g of haemoglobin (1) • correct calculation of oxygen in 100 cm^3 of blood (1)	72 % 72 / 100 X 1.36 = 0.9792 1.47 / 1.469 / 1.4688 cm^3 Correct answer gains full marks	**3**

Question Number	Answer	Additional Guidance	Mark
8 (a)(ii)	An explanation that makes reference to four of the following: • myoglobin (is on the left because) has a higher affinity for oxygen / binds more tightly to oxygen (1) • therefore it acts as a store for oxygen / only releases oxygen when oxygen is low (1) • haemoglobin is sigmoidal / S shaped / myoglobin is not S shaped (1) • as oxygen binds cooperatively (1) • so that the affinity varies depending on how much oxygen is bound (1)	**Accept** converse for oxygen e.g. haemoglobin releases oxygen more easily **Accept** correct description	**4**

Question Number	Answer	Additional Guidance	Mark
8(b)	An answer that makes reference to four of the following: • the (Tibetan haemoglobin) has a higher affinity for oxygen (1) • so that it is more saturated at lower pressures of oxygen (1) • with high carbon dioxide, the Tibetan haemoglobin has a lower affinity for oxygen (than Europeans) (1) • because it has a {more pronounced / bigger} Bohr shift / shift to the right (1) • so that it will release oxygen more easily (1)	**Accept** converse **Accept** oxygen concentrations **Accept** can bind oxygen at low pressures /can bind oxygen when at altitude where there is less partial pressure of oxygen **Accept** with higher carbon dioxide, Tibetan haemoglobin is less saturated (than European haemoglobin)	**4**

Question Number	Answer	Additional Guidance	Mark
8 (c) (i)	• calculation of q (1) • calculation of p (1) • calculation of number of heterozygotes (1)	Correct answer: 516 **Accept** answers with range of 517 and 528 with incorrect rounding for two marks Correct answer gains full marks **Accept** ECF for mp3 for 2pq x 2500	**3**

Question Number	Answer	Additional Guidance	Mark
8 (c)(ii)	An explanation that makes reference to the following: • only Tibetans and Denisovans have the allele (1) • so (the presence of the allele) suggests that Denisovans and Tibetans must have interbred (1) • and produced fertile offspring (1)	**Accept** Allele is present in Tibetans and Denisovans	**2**

Question Number	Answer	Additional Guidance	Mark
9(a)(i)	C 2 *A is incorrect as the nucleus and mitochondria have double membranes* *B is incorrect as the nucleus and mitochondria have double membranes* *D is incorrect as only the nucleus and mitochondria have double membranes*		**1**

Question Number	Answer	Additional Guidance	Mark
9 (a)(ii)	A 1 only *B is incorrect because voltage gated channels will not open when light affects rod cells* *C is incorrect because less neurotransmitter is released when light affects rod cells* *D is incorrect because less neurotransmitter is released when light affects rod cells*		**1**

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. • no light is seen at 15 degrees (D) • as there are no rods or cones at the blind spot (D) • cones are less sensitive than rods / can only detect bright light (R) • because they do not have spatial summation /rods have spatial summation (R) • cones are only found in the fovea / between 5° and 5° (R) • rods are not found in the fovea / between 5° and 5° / found everywhere except fovea / between 5° and 5° (R) • rods are stimulated by green light / 525 nm light (R) • rods are not stimulated by red light / 670 nm light (R) • dim red light /670 nm light is not seen at any angle because rods cells are not sensitive to red light / light of 670nm (S) • and cone cells are not sensitive enough (S) • bright red light / 670 nm light is only seen when on the fovea / between 5° and 5° because red cones are only on the fovea / not found outside the fovea (S) • and rod cells can not detect red light (S)

	• bright green light / 525nm light is seen everywhere apart from the blind spot / 15° because cone cells detect it in the fovea (S) • and rod cells detect green light / 525 nm light away from the fovea (S) • dim green light / 525 nm light is seen at angles greater than 10° because rod cells are sensitive to green light / 525 nm light (S) **Level 1: Only description (any 1 or 2 from B or R)** **Level 2: Elements of description of data and explanation but not fully linked (any 3 or 4 from B, R or S)** **Level 3: Description and explanations and linked well and no major errors (any 5 or 6 from B, R, S)**

Level	**Marks**	
Level	Marks	
0	0	No awardable content
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2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of all pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of all pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

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