

Mark Scheme (Results)

Summer 2018

Pearson Edexcel GCE
In Biology (9BI0) Paper 02
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.

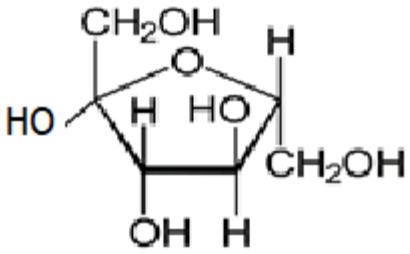
Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Additional Guidance	Mark
1(a)	An answer that makes reference to the following: **A** phospholipid (bilayer) and **B** (glyco) protein / (channel) protein / (integral) protein / (carrier) protein / (intrinsic) protein		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An explanation that makes reference to four of the following: • polar molecules are {charged / water soluble / hydrophilic} (1) • {phosphate / head} is hydrophilic / {fatty acids / tails} are hydrophobic (1) • {phosphate / head} on outer side / {fatty acids / tails} on inside (1) • therefore {polar / charged / ionic} substances do not pass through the {hydrophobic centre / fatty acids / tails} (1) • and so pass through {carrier / channel} proteins (1)		**(4)**

Question Number	Answer	Mark
2(a)(i)	**The only correct answer is B** ***A*** *is not correct because condensation joins monomers* ***C*** *is not correct because phosphorylation adds phosphate* ***D*** *is not correct because translocation does not break down sucrose*	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	• glucose and fructose	Reject beta glucose	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(iii)		**ACCEPT** HO or OH **ACCEPT** correct variations of fructose **ACCEPT** C's in ring **ACCEPT** line with nothing as H	**(1)**

Question Number	Answer	Mark
2(b)	**The only correct answer is B** ***A*** *is not correct because amylose has a helical and contains 1,4 glycosidic bonds* ***C*** *is not correct because amylose is not branched and does not contain 1,6 glycosidic bonds* ***D*** *is not correct because* amylose is not branched and does not contain 1,6 glycosidic bonds	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	An answer that makes reference to the following: One from: • (increase in) rates are same up to 30 to 32 (mg dm^{-3}) / at 13 (µg s^{-1}) (1) • both reduce rate up to 30 to 32 (mg dm^{-3}) / at 13 (µg s^{-1}) (1) Then: • B stops increasing but A continues to increase (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	An explanation that makes reference to the following • inhibitor B because reaction does not reach rate without inhibitor (1) • because it binds to {enzyme / allosteric site} (1) • changes {active site} (1)	**ACCEPT** levels off / plateaus / stays the same / does not maximum rate **DO NOT ACCEPT** binds to active site	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(a)	An explanation that makes reference to the following: • release energy / make ATP (1) • for {ion pump / Na^+ - K^+ pump / active transport of ions / regeneration of rhodopsin / combine opsin and retinal /convert trans retinal into cis retinal} (1)	**DO NOT ACCEPT** active transport alone	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)	A description that makes reference to four of the following: • rhodopsin involved (1) • retinal changes from cis to trans form / opsin and retinal formed (1) • {Na^+ / cation} channels close / Na^+ stop diffusing into rod cell (1) • Na^+ still moves out / inside cell becomes more negative / hyperpolarisation (1) • stops {glutamate / neurotransmitter} release (1)	**ACCEPT** blocks sodium channels	**(4)**

Question Number	Answer	Mark
4(a)(i)	**The only correct answer is C** ***A*** *is not correct because cellulose is not found in a bacterial cell* ***B*** *is not correct because cellulose and nucleoli are not found in a bacterial cell* ***D*** is not correct because nucleoli are not found in a bacterial cell	**(1)**

Question Number	Answer	Mark
4(a)(ii)	**The only correct answer is C** ***A*** *is not correct because Ebola contains RNA* ***B*** *is not correct because HIV contains RNA* ***D*** *is not correct because tobacco mosaic virus contains RNA*	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	An explanation that makes reference to the following: • the resolution is higher / better (1) • because wavelength of electrons is short(er) (1)	**ACCEPT** converse **ACCEPT** smaller wavelength	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	An explanation that makes reference to three of the following: • each domain has unique characteristics (1) • Archaea and Eukarya share three characteristics (1) • Archaea and Eukarya are more closely related / have a more recent common ancestor (1) • differences in {membrane lipids / ribosome size} evolved after Archaea and Eukarya split (1)	**ACCEPT** Archaea and Eukarya share more characteristics / share no rRNA loop, no antibiotic sensitivity and methionine **ACCEPT** branched carbon chains / ether linkage / 80 S	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	• peer review / (scientific) paper / (scientific) journal / (scientific) conference		**(1)**

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	time of cardiac cycle read from graph and divided into 60	60 ÷ 0.8 = 75 (beats per minute)	**(1)**

Question Number	Answer	Mark
5(a)(ii)	**The only correct answer is C** ***A*** *is not correct because the aortic pressure is higher than the ventricular pressure* ***B*** *is not correct because the aortic pressure is higher than the ventricular pressure between 0.10 s to 0.13 s* ***D*** *is not correct because the aortic pressure is higher than the ventricular pressure between 0.37 s and 0.43 s*	**(1)**

Question Number	Answer	Mark
5(a)(iii)	**The only correct answer is A** ***B*** *is not correct because 0.13 s is when the semi-lunar valve opens* ***C*** *is not correct because 0.37 s is when the semi-lunar valve closes* ***D*** *is not correct because 0.43 s is when the atrio-ventricular valve opens*	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)	A description that makes reference to five of the following: • (myogenic means) no external nerve impulses / doesn't require nerve impulse / no stimulation from brain / generated from within heart (1) • (contraction initiated by) SAN (1) • {depolarisation / wave of excitation} causes {atria to contract / atrial systole} (1) • delay at the AVN (1) • (depolarisation) through the {bundle of His / Purkyne fibres} (1) • (depolarisation) causing {ventricle to contract / ventricular systole} from base/apex of heart (1)	**ACCEPT** no outside stimulation (needed to contract heart) **ACCEPT** impulses	**(5)**

Question Number	Answer	Additional Guidance	Mark
5(c)	An explanation that makes reference to three of the following: • the heart rate is slower (1) • because noradrenaline and beta blocker are similar {shapes / structures} (1) • so beta blocker binds to noradrenaline receptors (1) • therefore {prevents / blocks} binding of noradrenaline (to receptors) (1)	**DO NOT ACCEPT** same shape	**(3)**

Question Number	Answer	Mark
6(a)(i)	**The only correct answer is C** ***A*** *is not correct because P is in prophase I and Q is in metaphase II* ***B*** *is not correct because P is in prophase I and Q is in metaphase II* ***D*** *is not correct because P is in prophase I and Q is in metaphase II*	**(1)**

Question Number	Answer	Mark
6(a)(ii)	**The only correct answer is B** ***A*** *is not correct because if non-disjunction occurred in meiosis I, it would generate one cell with four chromosomes (each composed of two chromatids) and one cell with two chromosomes (each composed of two chromatids). These cells would divide in meiosis II to generate two cells with four chromosomes and two cells with two chromosomes.* ***C*** *is not correct because if non-disjunction occurred in meiosis I, it would generate one cell with four chromosomes (each composed of two chromatids) and one cell with two chromosomes (each composed of two chromatids). These cells would divide in meiosis II to generate two cells with four chromosomes and two cells with two chromosomes.* ***D*** *is not correct because if non-disjunction occurred in meiosis I, it would generate one cell with four chromosomes (each composed of two chromatids) and one cell with two chromosomes (each composed of two chromatids). These cells would divide in meiosis II to generate two cells with four chromosomes and two cells with two chromosomes.*	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(b)	An answer that makes reference to the following: • number of pregnancies calculated (1) • number of babies calculated (1)	Correct answer gains full marks (500 000 ÷1000) x 14 = 7 000 (1.8 ÷ 100) x 7 000 = 126 or 14 x 500 = 7000 and then 7000 x 0.018 = 126	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(c)	An answer that makes reference to four of the following: • {screening / both techniques} are {more effective / produce more births} than control (1) • more embryos survive screening with polar body biopsy than PGD / polar body biopsy is less damaging than PGD (1) • PGD more effective (than polar body biopsy) / PGD produces more births (than polar body biopsy) (1) • (because) PGD produces 21% births compared to 18% with polar body (1) • PGD detects abnormalities in both paternal and maternal chromosomes / polar body biopsy only checks for maternal chromosome abnormalities (1)	**ACCEPT** converse **ACCEPT** converse **ACCEPT** converse **ACCEPT** 21.46 / 21.5 / 18.27 /18.3 **ACCEPT** 0.21 /0.215 / 0.18 / 0.183 / 0.1827 **DO NOT ACCEPT** just 21% alone **ACCEPT** ideas that polar body biopsy only screens for abnormalities from mother / PGD screens both parents	**(4)**

Question Number	Answer	Mark
7(a)	**The only correct answer is C** ***A*** *is not correct because allopatric selection is an incorrect term* ***B*** *is not correct because directional selection would move the curve in one direction* ***D*** *is not correct because stabilising selection would result in one peak*	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	different {alleles} in a gene pool / species / population OR different {species} in an {area / habitat / environment / ecosystem / community}	**ACCEPT** genetic variation within a species	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(ii)	An explanation that makes reference to the following: • only small number / 10 introduced / {founder effect / genetic bottleneck} has occurred / (1) • (resulting in a) limited gene pool / few different alleles / inbreeding in zoos / no other lynx present to provide new alleles (1)	**ACCEPT** converse for lynx in protected area **ACCEPT** converse for lynx in protected area **DO NOT ACCEPT** diversity of alleles	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(c)	An explanation that makes reference to four of the following: any **two** from • {use of zoos / seed banks / captivity} to {prevent extinction / protect endangered species} (1) • {education about /raising money for / raise awareness}importance of conservation (1) • {breeding programmes / controlled feeding / removing predation / protect from poaching / veterinary care} to increase {numbers / population} (1) and any **two** from • need to avoid inbreeding by use of stud books / frozen sperm (1) • **ethical** issues (1) • loss of normal behaviours (1)	**e.g** safari park **ACCEPT** any correct method **e.g**. cannot hunt / domesticated / reliant on humans	**(4)**

Question Number	Answer	Mark
8(a)	**The only correct answer is B** ***A*** *is not correct because X is the pelvis* ***C*** *is not correct because W is the cortex* ***D*** *is not correct because W is the cortex*	**(1)**

Question Number	Answer	Additional Guidance	Mark
8(b)	An explanation that makes reference to the following: • (substances) with higher (relative molecular) mass have a {lower ratio / ratio less than 1.00} (1) • small(er) substances pass through / large substances do not pass through (1) • because of the size of the pores in the {glomerulus / capillary / renal capsule / (basement) membrane} (1)	**ACCEPT** a ratio of 1.00 means substance passes through / a ratio less than 1.00 means not all substance passes through **ACCEPT** substances with a mass lower than 180 pass through	**(3)**

Question Number	Indicative content
***8 (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: Proximal convoluted tubule: **(P)** • glucose is all reabsorbed • by active transport / use of energy / use of ATP • urea concentration rises as water is reabsorbed • sodium ions absorbed because concentration does not increase (despite less water) Loop of Henle: **(L)** • urea concentration rises • sodium ion concentration rises in descending limb • water reabsorbed from descending limb • by osmosis • sodium ion concentration falls in ascending limb • sodium ions actively pumped out of ascending limb • reference to countercurrent multiplier Distal tubule and collecting duct: **(C)** • urea and sodium ion concentration rise • water is reabsorbed • by osmosis • ADH affects permeability

Level	Marks	
0	0	No awardable content
1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context. **Any number of descriptions from graph = 1 point** **Answer with description only and no explanation max 1** **1 REGION and at least one explanation = 2**
2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts to provide the explanation being presented. Lines of argument occasionally supported through the application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows some linkages and lines of reasoning with some structure. **2 REGIONS and 3 to 4 points**
3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to provide the explanation being presented. Line(s) of argument supported throughout by sustained application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows a well-developed and sustained line of reasoning which is clear, coherent and logically structured. **3 REGIONS and 5 plus points with no MAJOR errors** **e.g. urea moving into nephron, sodium ions moving into the nephron**

Question Number	Answer	Additional Guidance	Mark
9(a)(i)	An answer the makes reference to one of the following: gross primary productivity – respiration OR {energy / biomass} in producers which transfers to {next trophic level / primary consumers}	**ACCEPT** GPP – R	**(1)**

Question Number	Answer	Additional Guidance	Mark
9(a)(ii)	An explanation that makes reference to three of the following: • NPP increases as daylight and temperature increase (1) • because photosynthesis is greater than respiration (1) • NPP falls if respiration rate rises more than photosynthesis rate / GPP (1) • light is limiting factor (of photosynthesis) between {June and July / December and January} (1)	**ACCEPT** converse **ACCEPT** NPP is negative if the rate of respiration exceeds GPP / NPP is negative when respiration is greater than photosynthesis **ACCEPT** other correct examples of where light is a limiting factror	**(3)**

Question Number	Answer	Additional Guidance	Mark
9(b)(i)	An answer that makes reference to the following: • add losses and subtract from 127503 (1) • calculate percentage (1)	Correct answer gains full marks Correct answer: 8% 127 503 – 117 303 = 10 200 (10 200 ÷ 127 503) x 100 = 8(%) If answer wrong award one mark for 10 200 or division by 127 503 x 100	**(2)**

Question Number	Answer	Additional Guidance	Mark
9(b)(ii)	An explanation that makes reference three of the following: • different {organisms / trophic levels} {use / lose} different proportions of energy (1) and **two** from: • because of respiration for {movement / maintaining body temperature} (1) • because of material that is not digested (1) • because some parts are not consumed (1) • because some is lost due to excretion (1)	**ACCEPT** different {organisms / trophic levels} {use / lose} energy in different ways **ACCEPT** heat loss **ACCEPT** material is lost as faeces **ACCEPT** shedding of skin	**(3)**

Question Number	Answer	Additional Guidance	Mark
9(c)	An answer that makes reference to four of the following: • mass of wild tuna decreases more steeply (after 2002) (1) • there is a decrease in (wild tuna) caught after 2002 (1) • because farming takes {immature / young} from the wild population that have not reproduced / so breeding of tuna is reduced (1) • farming reduces food available for the wild population (reducing population) (1) • farming has not replaced the catch of wild tuna / consumer demand has risen (1)	**ACCEPT** idea of bigger increase after fish farming started **ACCEPT** total of caught + farmed has increased	**(4)**

Question Number	Answer	Additional Guidance	Mark
10 (a)(i)	An answer the makes reference to the following: • there is no difference between the number of expected and observed phenotypes		**(1)**

Question Number	Answer	Additional Guidance	Mark
10 (a)(ii)	An answer that makes reference to the following: • -15 225 0.25		**(1)**

Question Number	Answer	Additional Guidance	Mark
10(a)(iii)	An answer the makes reference to the following: • 3		**(1)**

Question Number	Answer	Additional Guidance	Mark
10(a)(iv)	An answer that makes reference to the following: • the {null hypothesis / H_o} is {accepted / not rejected} (1) • critical value is 7.815 (1) • there is a more than {0.05 / 5%} probability that the difference is due to chance / no significant difference / not significant (1)	**ACCEPT** clear indication in table **ACCEPT** for critical value is 6.251 **ACCEPT** (for critical value of 6.251) there is a more than {0.1 / 10%} probability that the difference is due to chance / no significant difference	**(3)**

Question Number	Indicative content
***10 (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: **(P)** • genotypes of the parents are NNGG and nngg • F_1 generation are all NnGg / heterozygous • the ratios are not in 9:3:3:1 ratio **(L)** • genes are linked / genes on same autosome / genes on same chromosome • crossing over has occurred / chiasmata • (most) gametes are NG and ng on one chromosome • smaller number of gametes as nG and Ng on one **(A)** • correct use of genetic diagrams • correct genotypes of F_2 • the normal wing and black body are recombinants / vestigial wing and grey body are recombinants • small number of recombinants suggest genes are closer together

Level	Marks	
0	0	No awardable content
1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context. **minimum 1 comment from P or L: 1 mark**
2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts to provide the explanation being presented. Lines of argument occasionally supported through the application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows some linkages and lines of reasoning with some structure. **minimum 3 comments from P AND L**
3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to provide the explanation being presented. Line(s) of argument supported throughout by sustained application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows a well-developed and sustained line of reasoning which is clear, coherent and logically structured. **minimum 2 comments from P AND 2 from L plus A with no major errors**

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