Mark Scheme (Results)

Summer 2018

Pearson Edexcel GCE

In Biology (9BI0) Paper 01

Advanced Biochemistry, Microbiology and Genetics

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Summer 2018
Publications Code 9BI0_01_1806_MS

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	Mark
1(a)(i)	**The only correct answer is A** ***B*** *is not correct because enzymes decrease reaction time* ***C*** *is not correct because enzymes decrease activation energy* ***D*** *is not correct because enzymes decrease activation energy and decrease reaction time*	**(1)**

Question Number	Answer	Mark
1(a)(ii)	**The only correct answer is D** ***A*** *is not correct because fibrin is not an enzyme* ***B*** *is not correct because fibrinogen is not an enzyme* ***C*** *is not correct because fibrinogen is not an enzyme*	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)	A description that makes reference to two of the following: • {increasing mass / more} (snake venom) decreases clotting time (1) • {small mass / 0.002 μg} of snake venom has a shorter clotting time (than Xa) (1) • {larger masses / 0.004 μg and over / 0.02 and 0.04} has little effect on clotting time (1)	**ACCEPT** clotting time is faster converse **ACCEPT** takes less time / faster rate **ACCEPT** 0.004 μg has slight increase and 0.02 μg and 0.04 μg has slight decrease	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)	form a {plug / mesh / scab / barrier / thrombus} to seal the {blood vessel / wound} / release {clotting factors / thromboplastin}	**ACCEPT** to stop bleeding / to prevent {infection / microorganisms entering} **DO NOT ACCEPT** prothrombin / thrombin / fibrinogen / fibrin	**(1)**

Question Number	Answer	Mark
2(a)	**The only correct answer is B** ***A*** *is not correct because glycosidic bonds join monosaccharides together* ***C*** *is not correct because peptide bonds join amino acids together* ***D*** *is not correct because phosphodiester bonds join adjacent mononucleotides together*	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)	A description that makes reference to the following: • removal of the {shaded nucleotides / introns} (1) • attachment of ACC (and OH) (1) • joining with phosphodiester bonds (1)	**ACCEPT** shaded {parts / areas} **ACCEPT** adding {acceptor stem / amino acid binding site}	**(3)**

Question Number	Answer	Mark
2(c)(i)	**The only correct answer is B** ***A*** *is not correct because G binds to C and U to A* ***C*** *is not correct because G binds to C and U to A* ***D*** *is not correct because G binds to C and U to A*	**(1)**

Question Number	Answer	Mark
2(c)(ii)	**The only correct answer is C** ***A*** *is not correct because C binds to G and A binds to T on DNA* ***B*** *is not correct because C binds to G and A binds to T on DNA* ***D*** *is not correct because C binds to G and A binds to T on DNA*	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	*Rhithrogena*	DO NOT ACCEPT *Rhithrogena germanica*	**(1)**

Question Number	Answer	Mark
3(a)(ii)	**The only correct answer is B** ***A*** *is not correct because Animalia is the kingdom* ***C*** *is not correct because Heptageniidae is the family* ***D*** *is not correct because Insecta is the class*	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)	An explanation that makes reference to four of the following: • as temperature increases up to 10°C hatching increases and then decreases (1) • enzyme activity affects {hatching / development / growth} (1) • (below 10°C) increase in temperature increases {kinetic energy / enzyme-substrate complexes / successful collisions between enzyme} (1) • (above10°C) temperature too high denatures enzymes (1) • higher temperature results in less dissolved oxygen available (1)	Piece together **ACCEPT** converse **DO NOT ACCEPT** starts to denature **ACCEPT** shape of active site changed	**(4)**

Question Number	Answer	Additional Guidance	Mark
3(c)	An answer that makes reference to three of the following: **Similarities:** • large surface area (1) • thin exchange surface / small diffusion distances (1) **Differences:** • nymphs have gills and adults have trachea / spiracles (1) • the nymph has external system and the adult has internal system (1)	**DO NOT PIECE TOGETHER** **ACCEPT** both have tracheoles if not awarded as a difference **ACCEPT** tracheoles if not awarded as a similarity **ACCEPT** gills on the outside and {spiracles / trachea / tracheoles} are on the inside	**(3)**

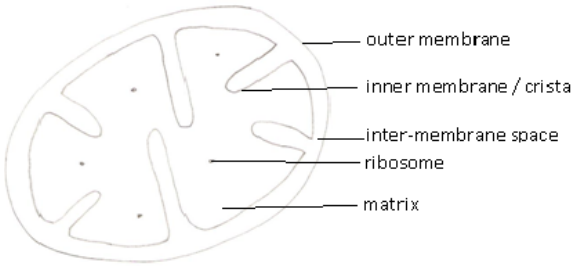
Question Number	Answer	Additional Guidance	Mark
4(a)	A description that makes reference to two of the following: • has a {tertiary structure / three dimensional structure (and quaternary structure)} (1) • held by named bond (1) • hydrophilic on the outside of the molecule (1)	**ACCEPT** hydrophobic R groups in the centre of the structure	**(2)**

Question Number	Answer	Mark
4(b)(i)	**The only correct answer is B** ***A*** *is not correct because no bonds are being broken* ***C*** *is not correct because no phosphate group is being added* ***D*** *is not correct because if FAD is reduced to* $FADH_2$ *the succinate is being oxidised*	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	An explanation that makes reference to four of the following: • completely oxidises {pyruvate / acetyl Co A} (1) • to release as much energy as possible (1) • to generate ATP (directly) (1) • to produce {reduced coenzyme / NADH} (1) • so that ATP can be produced {in the ETC / by oxidative phosphorylation} (1)	**ACCEPT** glucose **DO NOT ACCEPT** makes **ACCEPT** $FADH_2$ / FADH / reduced {NAD / NADH} / reduced {FAD / FADH / $FADH_2$}	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	concentration of protein read from graph	0.58 / 0.57 (mg cm^{-3})	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	• initial rate of reaction calculated (1) • ratio calculated (1)	0.00267 / 0.0027 (mg sec^{-1}) / 0.16 (mg min^{-1}) 0.58 : 0.0027 = 214.81 : 1 or 3.63 : 1 21481 : 100 or 363 : 100 0.57 : 0.0027 = 211.11 : 1 or 3.56 : 1 21111 : 100 or 356 :100 **CE applies from both 4(c)(i) and the value for initial rate of reaction**	(2)

Question Number	Answer	Additional Guidance	Mark
5(a)	A drawing that shows the following: Drawing marks : • 2 membranes drawn (1) • (continuous) inner membrane (of two) folded (1) Label marks : Any **two** from • {inner membrane / crista} and outer membrane (1) • inter-membrane space (1) • matrix (1) • ribosome (1)		**(4)**

Question Number	Answer	Mark
5(b)(i)	**The only correct answer is A** ***B*** *is not correct because the father's mitochondria do not enter the ovum on fertilisation* ***C*** *is not correct because only the nucleus was used from the mother* ***D*** *is not correct because only the nucleus was used from the mother and the father's mitochondria do not enter the ovum on fertilisation*	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An explanation that makes reference to three of the following: • zygote divides by mitosis (several times to form blastocyst) (1) • to make identical copies of the {DNA (molecules) / chromatids} (1) • so that all cells (in the blastocyst) {will be diploid / have two copies of each chromosome} (1) • so that when the mitochondria divide they will have a copy of the DNA (1)	**ACCEPT** genetically-identical (daughter) cells / same genetic information **ACCEPT** correct number of chromosome / 46 chromosomes / 23 pairs **ACCEPT** mitochondrial DNA divides	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(a)	A description that makes reference to the following: • antigen on {surface / membrane} of macrophage (1) • binding of antigen to {CD4 / receptor} on T helper cell (1)	ACCEPT antigen on MHC on macrophage	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	An explanation that makes reference to the following: • to prevent DNA {replication / unwinding / unzipping} (1) • so that macrophages could not {divide / carry out mitosis} (1) • so that any division could be attributed to the T cells only / radioactive thymidine incorporated into T cells only (1)	**ACCEPT** separating **ACCEPT** number of macrophages remains constant **ACCEPT** no thymidine incorporated into the macrophage	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	An explanation that makes reference to two of the following: • {complementary to / binds to / forms H bonds with} adenine (on the DNA) (1) • forming phosphodiester bonds (with adjacent nucleotides) (1)	**ACCEPT** formation of a sugar-phosphate backbone	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(iii)	An explanation that makes reference to four of the following: • most (radioactive) thymidine incorporated into T cells that were the same strain as the macrophages (1) • because these cells are dividing more (1) • because {the (MHC and CD4) receptors bind together better / antigen presentation improved} (1) • due to genetic compatibility (1) • strain 2 {macrophages are better antigen presenters / T cell proliferate faster than strain 13} (1)	**ACCEPT** converse throughout **ACCEPT** more T cells if antigen is presented by macrophages from same {strain / number} guinea pig description **ACCEPT** faster mitosis **ACCEPT** better recognition **ACCEPT** self-antigens **ACCEPT** antigen presentation is more effective	**(4)**

Question Number	Answer	Mark
7(a)(i)	**The only correct answer is D** ***A*** *is not correct because xylem carries water and mineral ions and the sucrose is in solution in the phloem* ***B*** *is not correct because xylem carries water and mineral ions* ***C*** *is not correct because the sucrose is in solution in the phloem*	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	A description that makes reference to **three** of the following: • xylem cell walls contain {cellulose and lignin / lignin} but phloem cell walls contain {only cellulose / no lignin} (1) • xylem is {hollow / no end walls} but phloem has {cell contents / sieve plates} (1) • xylem has pits but phloem does not (1) • xylem {does not have companion cells / is dead} but phloem has companion cells (1)	**Do not piece together unless points are clearly paired in adjacent sentences** **ACCEPT** xylem has thick cell walls but phloem has thinner cell walls {xylem is / xylem cells are} lignified **ACCEPT** {modified / enlarged} plasmodesmata	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	A description that makes reference to the following: • as the pressure gradient increases there is (a linear) increase in the velocity (for all three radii) (1) • as the radius of the xylem increases the velocity increases (1)	**ACCEPT converse for both points** **ACCEPT** higher the pressure gradient the higher the velocity **ACCEPT** greater the radius the higher the velocity	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)(ii)	• velocities read from graph (1) • correct percentage calculated (1)	156 / 157 and 61 / 62 (156 - 61) x 100 ÷ 61 = 155.73 / 155.7 / 156 % (156 - 62) × 100 ÷ 62 = 151.61 / 151.6 / 152 % (157 - 61) x 100 ÷ 61 = 157.38 / 157.4 / 157 % (157 - 62) × 100 ÷ 62 = 153.23 / 153.2 / 153 % CE applies if 155 / 158 and / or 63 given as values from graph (155 – 61) ×100 ÷ 61 = 154.1 / 154 % (155 – 62) ×100 ÷ 62 = 150 % (155 – 63) ×100 ÷ 63 = 146.03 / 146 % (156 - 63) x 100 ÷ 63 = 147.62 / 147.6 / 148 % (157 - 63) x 100 ÷ 63 = 149.21 / 149.2 / 149 % (158 – 61) ×100 ÷ 61 = 159.02 / 159 % (158 – 62) ×100 ÷ 62 = 154.84 / 154.8 / 155 % (158 – 63) ×100 ÷ 63 = 150.79 / 150.8 / 151 %	**(2)**

Question Number	Indicative content
***7(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: • male gamete fertilise female gamete to produce embryo • one male gamete fuses with {both polar nuclei / (diploid) endosperm nucleus} to form a triploid endosperm nucleus • endosperm is a store of {starch / protein / oils} • ovules will become the seeds inside the berries • xylem transports the water needed for berry formation shown in graph 1 • xylem transports the water needed for hydrolysis of food stores • xylem transports mineral ions for berry formation • phloem transports the sucrose needed for berry formation and ripening in graph 2 • more sucrose is transported from the leaves when berries are present in graph 2 • ^{14}C incorporated into glucose during photosynthesis • glucose converted into sucrose for transport in the phloem

Level 0	Marks	No awardable content
Level 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 or 3 comments made which may include description of graphs and / or explanations**
Level 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. **4 of 5 comments that include explanations with reference to at least two components**
Level 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. **6 or 7 comments that include explanations with reference to all three components**

Question Number	Answer	Mark
8(a)	**The only correct answer is C** ***A*** *is not correct because Salmonella are gram negative bacteria so will have a thin peptidoglycan cell wall* ***B*** *is not correct because Salmonella are gram negative bacteria so will have a thin peptidoglycan cell wall and they produces endotoxins* ***D*** *is not correct because Salmonella produces endotoxins*	**(1)**

Question Number	Answer	Additional Guidance	Mark
8(b)(i)	An explanation that makes reference to four of the following: • medium allows only {*Salmonella* / certain bacteria} to grow (1) • {culture / colonies / bacteria} is spread out on the {agar / medium} (1) • because this separates out individual bacteria (1) • so that colonies are {discrete / separate / individual} (1) • so only one type of {bacteria / colony} can be picked up (1)	**ACCEPT** in context of {named media / antibiotic-containing media}	**(4)**

Question Number	Answer	Additional Guidance	Mark
8(b)(ii)	• log of the values taken (1)	log 5 x 10^3 = 3.6989700043 and log 4 x 10^6 = 6.6020599913	
	• substitution of values into equation (and evaluating correctly) (1)	(6.6020599913 - 3.6989700043) ÷ (0.301 × 10) = 0.9644817233 **ACCEPT** correct value for rounded up values substituted	
	• k given to an appropriate number of decimal places (1)	0.964 / 0.96	
		CE applies from mp 1 only	(3)

Question Number	Answer	Additional Guidance	Mark
8(b)(iii)	An explanation that makes reference to the following:		
	• the value for t used in the calculated value is greater than the actual value (1)	**ACCEPT** converse for actual value	
	• therefore the calculated value for k will be smaller (1)	**ACCEPT** converse for actual value	
	• because the *Salmonella* will not be replicating (in lag phase) (1)	**ACCEPT** dividing / growing	**(3)**

Question Number	Answer	Additional Guidance	Mark
9(a)	• tonnes produced by Brazil calculated (1) • yield calculated for each country (1) • difference calculated (1)	**ALLOW** values that are correctly rounded up in the first two steps of the calculation (93 million x 100) ÷ 109.4 = 85.00914077 (million tonnes) 93 million ÷ 31 million = 3 (tonnes per hectare) and 85.00914077 million ÷ 28 million = 3.036040742 (tonnes per hectare) 3.036 - 3 = {0.036 / 0.04} tonnes (per hectare less by US / more by Brazil) **CE applies throughout**	**(3)**

Question Number	Indicative content
***9(b)(i)**	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. <u>Indicative content</u> **Table 1** • Ponta Grossa: transgenic plants have higher mineral content than non-transgenic plants • Londrina: transgenic plants have lower mineral content that non-transgenic plants • Transgenic plants: plants grown in Ponta Grossa have lower mineral content than plants grown in Londrina • Non-transgenic plants: plants grown in Ponta Grossa have lower mineral content than plants grown in Londrina • Londrina:both types of soybean have more mineral content than both types in Ponta Grossa **Table 2** • Ponta Grossa: transgenic plants have higher protein and lipid but lower carbohydrate content than non-transgenic plants • Londrina: transgenic plants have higher lipid but lower protein and carbohydrate content than non-transgenic plants • Transgenic plants: plants grown in Ponta Grossa have higher lipid but lower protein and carbohydrate content than plants grown in Londrina • Non-transgenic plants: plants grown in Ponta Grossa have higher lipid but lower protein and carbohydrate content than plants grown in Londrina • Londrina: both types of soybean have more protein and carbohydrate but lower lipid than both types in Ponta Grossa

	Examples of Conclusions • Londrina soybeans are (generally) the most nutritious • In Londrina, non-transgenic soybeans are more nutritious • In Ponta Grossa, transgenic soybeans are more nutritious • Very little difference in nutritional content overall	
Level 0	Marks	No awardable content
Level 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 comparisons / conclusions
Level 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. 4 / 5 comparisons / conclusions
Level 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. 6 / more comparisons and conclusions

Question Number	Answer	Additional Guidance	Mark
9(b)(ii)	An explanation that makes reference to five of the following: • Londrina (has a more fertile soil therefore the) soya beans will have a higher {mineral / mineral ion / ion / named mineral ion} content (1) • Londrina (has a more fertile soil therefore the) soya beans will have a higher protein content as there will be more nitrates (1) • Londrina has a higher temperature so {photosynthesis / Calvin cycle / carbon fixation} will be faster (1) • as {enzymes / RUBISCO} will {increase rate of reactions / have more kinetic energy} (1) • therefore making more {organic molecules / carbohydrate / named carbohydrate / protein} (1) • Londrina has a higher rainfall therefore more water for {photolysis / transport of minerals} (1)	**ACCEPT** {photosynthesise faster as more magnesium ions for chlorophyll / be stronger as more calcium ions for cell walls / more phosphate for ATP or nucleic acid synthesis} **ACCEPT** greater activity / work faster **ACCEPT** light-dependent reactions	**(5)**

Question Number	Answer	Additional Guidance	Mark
9(b)(iii)	An explanation that makes reference to the following: • to compare the fatty acids in the two types of soya bean (1) • so that {the (transgenic) soybeans will be less likely to increase the risk of heart disease / oxidation is less likely} (1)	**ACCEPT** to see if there were less saturated fatty acids / less linoleic acid / more oleic acid **ACCEPT** converse less likely to go rancid oleic acid less likely to oxidise than linoleic acid	**(2)**

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