Mark Scheme (Results)

Summer 2022

Pearson Edexcel GCE
In Biology B (9BI0/01)
Paper 1: Advanced Biochemistry, Microbiology and Genetics

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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 respons

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	• *Salmonella* (species) (1)	**ACCEPT** phonetic spellings **ACCEPT** *Shigella, Neisseria, Escherichia, Pseudomonas, Klebsiella, Proteus, Providencia, Escherichia, Morganella, Aeromonas, Citrobacter* **ACCEPT** specific examples e.g. *E.coli* **DO NOT ACCEPT** gram positive bacteria e.g. *Actinomyces, Clostridium, Mycobacterium, Streptococci, Staphylococci, Nocardia*	(1)

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	• gram negative bacteria have {a thinner peptidoglycan cell wall / an (outer) lipopolysaccharide (layer) / an outer membrane } (1)	**ACCEPT converse for gram positive bacteria** **ACCEPT** less peptidoglycan murein for peptidoglycan larger periplasm (space) no teichoic acid (in cell wall)	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	• 0.308 / 0.31 / 0.3 (1)		(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An answer that makes reference to two of the following: • endotoxins released from Gram negative bacteria (only) but exotoxins released from both Gram negative and Gram positive bacteria (1) • endotoxins are lipopolysaccharides but exotoxins are proteins (1) • endotoxins released from {dead / broken down} bacteria but exotoxins are released from living bacteria (1) • effect of endotoxins is later (1)		(2)

Question Number	Answer	Additional Guidance	Mark
2(a)	An explanation that makes reference to two of the following: • meiosis results in recombination of alleles (1) • due to {independent / random} assortment (of chromosomes) (1) • (and) due to crossing over between chromatids (between the same homologous chromosomes) (1)	**ACCEPT** description e.g. pairs of homologous chromosomes line up (on the equator) randomly **ACCEPT** description e.g. genetic material is swapped between chromatids (between the same homologous chromosomes) **DO NOT ACCEPT** wrong description/ wrong stage	(2)

Question Number	Answer	Additional Guidance	Mark
2(b)	A description that makes reference to three of the following: • (contact between sperm and secondary oocyte results in) <u>acrosome</u> reaction (1) • meiosis is completed (1) • <u>cortical</u> reaction takes place (1) • fusion of sperm {nucleus / genetic material} with {nucleus genetic material} of ovum (1)	**ACCEPT** ovum / egg cell / female gamete description e.g. enzymes are released from the <u>acrosome</u> **DO NOT ACCEPT** if described after cortical reaction or fusion of two cells **ACCEPT** description e.g. <u>cortical</u> granules are released that {hardens the membrane / forms a fertilisation membrane} **ACCEPT** egg cell / nuclei of the gametes	(3)

Question Number	Answer	Additional Guidance	Mark
3(a)	**The only correct answer is A** **B** is incorrect because *Plasmodium* is the genus name not the species name **C** is incorrect because *Plasmodium* causes malaria not *Puccinia* **D** is incorrect because *Plasmodium* causes malaria not *Puccinia*		(1)

Question Number	Answer	Additional Guidance	Mark
3(b)	A description that makes reference to three of the following: • {gene / DNA / genetic material} coding for toxin isolated (from the spiders) (1) • using {restriction enzymes / (restriction) endonucleases} (1) • (spider) gene inserted into fungus using a {vector / named vector} (1) • genetically-modified fungi {identified / cloned / cultured} (1)	**ACCEPT** mRNA isolated and used to synthesise the gene / base sequence of gene determined and used to synthesise a gene **ACCEPT** in context of vector DNA e.g. virus / plasmid / gene gun / injection **ACCEPT** replicate / reproduce	(3)

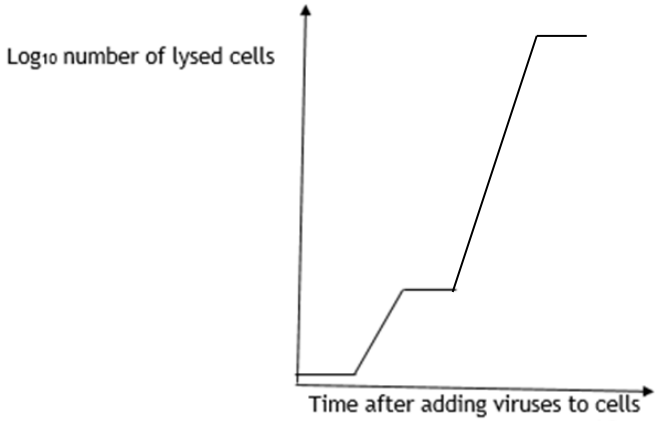
Question Number	Answer	Additional Guidance	Mark
3(c)	An explanation that makes reference to three of the following: • not unethical as mosquitoes not killed (1) • risk of other organisms being affected by the genetically-modified fungus is avoided (1) • organisms that feed on mosquitoes will not lose their food supply (1) • some people believe that modifying DNA is {wrong / unethical} (1)	**ACCEPT** converse for other approach e.g. toxins could harm other organisms, transfer of genes into other organisms **ACCEPT** unknown risks **ACCEPT** biodiversity maintained / ecosystems not disrupted / food chain not disrupted	(3)

Question Number	Answer	Additional Guidance	Mark
4(a)	**The only correct answer is A** **B** is incorrect because the capsid is complex not helical **C** is incorrect because DNA is the genetic material not RNA **D** is incorrect because DNA is the genetic material not RNA		(1)

Question Number	Answer	Additional Guidance	Mark
4(b)	• drawing length of bacteria given in μm or nm / drawing length of virus given in μm or nm **OR** • ratio of drawing length (1) • actual length of virus given in nm, to the nearest whole number, value between 103 and 143 (1)	**ACCEPT** between 95 000 μm / 95 000 000 nm and 115 000 μm / 115 000 000 nm for bacteria between 7 000 μm / 7 000 000 nm and 8 000 μm / 8 000 000 nm for virus **ACCEPT** between 95 mm and 115 mm for bacteria and between 7 mm and 8 mm for virus ecf if numerals correct but order of magnitude wrong	(2)

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	An explanation that makes reference to three of the following: • virus to attach to host cells / {genetic material / DNA} to enter host cells (1) • synthesis of DNA (1) • {protein synthesis / transcription and translation} (1) • assembly of new viruses (1)	**ACCEPT** virus {enters / infects} **DO NOT ACCEPT** RNA **DO NOT ACCEPT** RNA unless already penalised in mp 1 / in the context of {proviruses / latency} **ACCEPT** capsid / capsomeres / tail / base plate / tail (fibres) / collar / J protein / enzymes / protease / permease / other named proteins will need to be checked **DO NOT ACCEPT** reverse transcriptase / integrase **NB ACCEPT** (time for) {replication / multiplication} of the virus in correct context if no other marks awarded.	(3)

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	• correct values read from graph and divided by the time (1) • mean rate calculated (1)	3.8 and 1.7 and a division by 40 156 ecf wrong time value but correct answer to whole number e.g.(30 mins) 209 Correct answer only = 2 marks	(2)

Question Number	Answer	Additional Guidance	Mark
4(c)(iii)	• line going up and (generally) levelling off (1) • increase greater than the first increase (1)		(2)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	**The only correct answer is A** **B** is incorrect because light-dependent stage takes place on thylakoid membrane and not in the stroma **C** is incorrect because light-dependent stage takes place on thylakoid membrane and not on the inner membrane **D** is incorrect because light-dependent stage takes place on thylakoid membrane and not on the outer membrane		(1)

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	**The only correct answer is A** **B** is incorrect because hydrogen ions accumulate inside the thylakoids and not in the starch grain **C** is incorrect because hydrogen ions accumulate inside the thylakoids and not in the DNA loop **D** is incorrect because hydrogen ions accumulate inside the thylakoids and not in the inner membrane space		(1)

Question Number	Answer	Additional Guidance	Mark
5(a)(iii)	**The only correct answer is D** **A** is incorrect because translation occurs on the ribosomes and not inside the thylakoids **B** is incorrect because translation occurs on the ribosomes and not in the starch grain **C** is incorrect because translation occurs on the ribosomes and not in the DNA loop		(1)

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	**The only correct answer is C** **A** is incorrect because per area is m^{-2} **B** is incorrect because per area is m^{-2} and per second is sec^{-1} **C** is incorrect because per second is sec^{-1}		(1)

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An answer that makes reference to three of the following: • as temperature increases so does rate of photosynthesis (1) • rate of photosynthesis is faster in high levels of carbon dioxide (1) • the optimum temperature for photosynthesis is higher in higher levels of carbon dioxide (1) • optimum for photosynthesis are high levels of carbon dioxide and a temperature of 37°C (1)	**ACCEPT** converse throughout **ACCEPT** temp value between 35.5 and 36.5	(3)

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	An explanation that makes reference to four of the following: • more carbon dioxide and higher temperatures (below optimum) mean more GALP formed (1) • higher carbon dioxide concentration means {more carbon dioxide for / faster} {light-independent stage / Calvin cycle / carbon fixation} (1) • higher temperatures means that RUBISCO can catalyse carbon fixation faster (1) • because more (kinetic / heat) energy so more {enzyme-substrate complexes / energetic collisions between enzymes and substrates} (1) • therefore GP formed to be converted into GALP (1)	**ACCEPT** converse throughout **ACCEPT** pieced together **ACCEPT** description e.g. carbon dioxide reacting with RuBP **ACCEPT** temperatures too high, RUBISCO will denature	(4)

Question Number	Answer	Additional Guidance	Mark
6(a)	A description that makes reference to the following: • glycerol attached to two fatty acids (by ester bonds) (1) • and one phosphate attached to glycerol (1)	**ACCEPT** from a labelled diagram **NB** made from one glycerol two fatty acids and one phosphate = 1 mark if neither mark awarded	(2)

Question Number	Answer	Additional Guidance	Mark
6(b)	An explanation that makes reference to the following: • because the {two polar groups / outside layers} will interact with the aqueous environment (on each side of membrane) (1) • rest of molecule will provide hydrophobic barrier / there will be a hydrophobic layer (inside) (1)	**ACCEPT** form H bonds with water	(2)

Question Number	Answer	Additional Guidance	Mark
6(c)(i)	• 1.5 (%)		(1)

Question Number	Answer	Additional Guidance	Mark
6(c)(ii)	A description that makes reference to two of the following: • bacteria with higher optimum growth temperatures have a greater percentage of branched chain fatty acids (1) • the greater the percentage of branched chain fatty acids the greater the range of optimum growth temperature (1) • an optimum growth temperature of more than 40°C needs at least 30% of branched chains (1)	**ACCEPT** positive correlation between optimum growth temperature and percentage of branched-chain fatty acids converse **ACCEPT** bacteria with optimum temperature between 20°C and 40°C had the greatest range in percentage of branched-chain fatty acids converse	(2)

Question Number	Answer	Additional Guidance	Mark
6(d)	An explanation that makes reference to the following: • because membranes control {permeability / what can enter and leave the cell} (1) • such as {uptake of nutrients / uptake of oxygen / removal of waste products} (1) • because membranes need to be fluid for {movement / cell division} (1)	**ACCEPT** converse i.e. what would happen if membrane composition did not change **ACCEPT** membranes become more {permeable / leaky} at higher temperatures **ACCEPT** named nutrients / waste products	(3)

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	**The only correct answer is D** **A** is incorrect because antibodies have two antigen binding sites **B** is incorrect because the two binding sites attach to the antigen and not the macrophage **C** is incorrect because there is only one macrophage binding site		(1)

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	**The only correct answer is B** **A** is incorrect because hydrolysis reactions breakdown molecules **C** is incorrect because nucleotides are the monomers of polynucleotides not proteins **D** is incorrect because nucleotides are the monomers of polynucleotides not proteins		(1)

Question Number	Answer	Additional Guidance	Mark
7(a)(iii)	An explanation that makes reference to the following: • (because water enters part of cell) by osmosis (1) • from a high water potential to a low water potential / because the osmotic potential inside the cell is lower / from a low solute concentration to a higher solute concentration (1)	**ACCEPT** more concentrated cytoplasm solute potential for osmotic potential	(2)

Question Number	Answer	Additional Guidance	Mark
7(a)(iv)	A description that makes reference to three of the following: • bacteria engulfed and {digested / broken down} (1) • antigen attached to MHC antigen (1) • macrophage becomes an antigen-presenting cell (to the T helper cell) (1) • CD4 (antigen) of T (helper) cell binds to {antigen / macrophage} (1)	**ACCEPT** macrophage presents the antigen (to the T helper cell) **NB** CD4 (antigen) of T (helper) cell binds to {antigen-MHC complex = 2 marks	(3)

Question Number	Indicative content		Mark
***7(b)**	**Indicative content:** **Graph 1** (concentration of bacteria) • as time increases the number of bacteria taken up increases • the more microorganisms present the more enhanced the uptake is • but this is not proportional to number present • effect only seen after 10 minutes **Graph 2** (number of macrophages) • the more macrophages present the more uptake of bacteria • but this difference is only marked with 100 000 macrophages present • effect only seen after 30 minutes **Graph 3** (source of macrophages) • source of macrophages affects how many bacteria are taken up • bone marrow cells take up more of both types of bacteria • type of bacteria affects how many bacteria are taken up • combination of both affects uptake **Graph 4** (concentration of ATP synthase inhibitor) • presence of ATP synthase inhibitor reduces uptake of bacteria • as there is no ATP available for phagocytosis • but differences only really seen are concentrations of 100 a.u. and above	**Level 1:** 1 mark = 1 comment on one set of data 2 marks = two sets of data commented on **Level 2:** Comments must relate to phagocytosis ie not just a description of green glow 3 marks = three sets of data commented on 4 marks = four sets of data commented on **Level 3:** 5 marks = four sets of data commented on, with an extended comment on one set 6 marks = four sets of data commented on, with an extended comment on at least two sets of data	6

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	• (other : pulmonary) 2.5 : 1 / 2.5 / 1 : 0.4 / 0.4 (pulmonary : other) 1 : 2.5 / 2.5 / 0.4 : 1 / 0.4	**DO NOT ACCEPT** with units	(1)

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	An explanation that makes reference to the following: • (partial pressure of oxygen is low in) pulmonary artery is carrying deoxygenated blood to lungs (1) • (partial pressure of oxygen is high in) arterial blood is carrying oxygenated blood to the {body / cells / tissues} (1)	**NB** piece together **ACCEPT** deoxygenated as it has come back from the body **ACCEPT** oxygenated as it has been through lungs	(2)

Question Number	Answer	Additional Guidance	Mark
8(b)(i)	An explanation that makes reference to two of the following: • because HIF can switch on gene (expression) (1) • bind to a promotor region / stimulate transcription / stimulate protein synthesis} (1) • for {enzymes / proteins} involved in glycolysis (1)	**ACCEPT** increased gene expression **ACCEPT** increase rate of transcription **IGNORE** enzymes **ACCEPT** named {enzyme / protein} involved in glycolysis e.g. enzyme that makes NAD	(2)

Question Number	Answer	Additional Guidance	Mark
8(b)(ii)	An explanation that makes reference to the following: • (because if conditions are hypoxic) there is not much oxygen available to act as a terminal electron acceptor (1) • therefore the electron transport chain will not operate (1) • therefore ATP production by oxidative phosphorylation will be reduced (1) • ATP is produced (directly / SLP) during glycolysis (during these anaerobic conditions) (1)	**ACCEPT** no oxygen	(4)

Question Number	Answer	Additional Guidance	Mark
8(b)(iii)	An answer that makes reference to the following: • both HIF-1 and HIF-2 increase (during hypoxia) (1) • levels of HIF-2 remain high (after a small decrease) but levels of HIF-1 fall (1)	**DO NOT PIECE TOGETHER**	(2)

Question Number	Answer	Additional Guidance	Mark
8(b)(iv)	An explanation that makes reference to two of the following: • HIF-1 and HIF-2 switch on different genes (1) • {products / transcription of genes} resulting from the presence of both HIF-1 and HIF-2 are needed in the early stages of hypoxia (1) • {products / transcription of gene} resulting from the presence of HIF-2 are needed {for longer periods of hypoxia / to sustain glycolysis} (1)	**ACCEPT** bind to different promotor regions **ACCEPT** converse for HIF-1	(2)

Question Number	Answer	**Additional Guidance**	Mark
9(a)(i)	**The only correct answer is B** **A** is incorrect because respiration takes place in the root **C** is incorrect because photosynthesis does not take place in the root **D** is incorrect because respiration takes place in the root		(1)

Question Number	Answer	Additional Guidance	Mark
9(a)(ii)	**The only correct answer is A** **B** is incorrect because pits are in the xylem **C** is incorrect because plasmodesmata are between cells **D** is incorrect because stomata are in the leaves		(1)

Question Number	Answer	Additional Guidance	Mark
9(b)(i)	• insect weighed before and after investigation and the difference calculated (1)		(1)

Question Number	Answer	Additional Guidance	Mark
9(b)(ii)	• 42.86 (%)		(1)

Question Number	Answer	Additional Guidance	Mark
9(b)(iii)	An explanation that makes reference to two of the following: • as a standard for comparison (1) • to prevent {water loss / dehydration} (before the start of the investigation) (1) • as this is the highest humidity {they could tolerate / that could be produced} (1)	**ACCEPT** a description e.g. so that the effects of lower humidities can be seen **ACCEPT** reduce water loss so there will be water in the tracheoles **ACCEPT** higher humidities might be harmful	(2)

Question Number	Answer	Additional Guidance	Mark
9(b)(iv)	An explanation that makes reference to three of the following: • water loss increases with decrease in humidity as there is more room for water molecules (1) • less water loss at {low / 20% / 0%} humidity in air because spiracles close (1) • water loss is greater in air with higher levels of carbon dioxide as ventilation rate is faster (1) • and the spiracles stay open (1)	**ACCEPT** converse where appropriate **ACCEPT** fewer water molecules in air / down a (water vapour) concentration gradient (into air) **ACCEPT** breathing rate / gas exchange	(3)

Question Number	Answer	Additional Guidance	Mark
9(c)(i)	• 7.776×10^6 / 7.78×10^6 / 7.8×10^6 / 8×10^6		(1)

Question Number	Indicative content		Mark
***9(c)(ii)**	<u>Indicative content</u> Gill filaments: • active fish (generally) have a greater number of gill filaments than inactive fish • the exception is the heaviest inactive fish, *Tinca* • maybe a weak correlation between number of filaments and mass of active fish Lamellae: • active fish (generally) have more lamellae on each filament • but this does not correlate with the mass of the fish • *Tinca* is the inactive fish with the highest total number of gill filaments • 1.9×10^6 • which is way lower than *Thunnus* • and only slightly above the active fish with the least number Surface area: • active fish (generally) have a greater surface are of gills than inactive fish of similar mass • but no correlation with mass Diffusion distance: • very little data on diffusion distance • active fish seem to hoave a smaller diffusion distance • but no obvious correlation with activity or mass Explanations: • higher {number of filaments / lamellae / surface area} increases gas exchange • a smaller diffusion increases gas exchange • so more oxygen available for aerobic respiration • therefore more ATP can be generated • for the contraction of muscles (of the active fish) • more energy needed for movement of heavier fish	**Level 1:** 1 mark = one gill aspect commented on 2 marks = two gill aspects commented on **Level 2:** 3 marks = two gill aspects commented on with an explanation 4 marks = three gill aspects commented on with an explanation **Level 3:** 5 marks = four gill aspects commented on, with an explanation 6 marks = four gill aspects commented on, with an explanation linking to muscle contraction	6

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