PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 5: ENERGY FOR BIOLOGICAL PROCESSES

OXIDATIVE PHOSPHORYLATION

SCORE	PERCENTAGE
/81	%

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Mark Scheme

Q1.

Question Number	Answer	Mark
(a)	molecule R - ATP / adenosine triphosphate ; molecule S - ADP / adenosine diphosphate ;	**(2)**

Question Number	Answer	Mark
(b)(i)	1. carbon dioxide / CO_2 ; 2. idea that the C has been removed from C_6 or C_5 ;	**(2)**

Question Number	Answer	Mark
(b) (ii)	1. cycle would stop / eq ; 2. 4 carbon compound would accumulate / eq ; 3. 6 carbon compound would {run short / not be synthesised} / 5 carbon compound would run short / eq ; 4. idea that {molecule T / H} reduce ;	**(3)**

Question Number	Answer	Mark
(c)	1. idea of electrons being {passed along / eq} the electron transport chain ; 2. idea of {losing / eq} energy ; 3. (used to) add a phosphate to ADP to make ATP / eq ; 4. reference to ATPase ; 5. idea of chemiosmosis ; 6. idea of oxygen as the final acceptor ;	**(3)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following: • oxygen in blood decreases as it moves into {muscles / cells / named cell} for (aerobic) respiration (1) • blood retains some oxygen (even though the muscles are depleted) (1) • this is to supply oxygen to the brain so that the cells do not die(1) • oxygen decreases in muscles as it is used to generate ATP formuscle contraction (1)	**ACCEPT** energy	(3)

Q3.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • lactic acid (accumulation) in the muscles is toxic (1) • therefore it passes from the muscles into the blood (1) • lactic acid is taken from the muscles to the liver by the blood (1) • drop in pH (caused by lactic acid) will denature enzymes (in thecells / blood) (1)		(3)

Q4.

Question Number	Answer	Mark
(a)	1. idea that less {food /eq} required to deliver energy requirement ; 2. (so) more likely to have extra food not respired / {extra/surplus} energy ; 3. which could be laid down in body as fat / eq ;	**(2)**

Question Number	Answer	Mark
(b)	Any two from: 1. ADP 2. Pi / inorganic phosphate 3. pyruvate / pyruvic acid / lactate 4. fatty acids 5. NAD / eq 6. acetyl CoA / eq 7. water ; ;	**(2)**

Question Number	Answer	Mark
(c)	1. many {alpha / eq} glucose monomers ; 2. joined by glycosidic bonds ; 3. detail of glycosidic bonds e.g. 1-4 ; 4. reference to side branches present / 1-6 glycosidic bonds ;	**(3)**

Question Number	Answer	Mark
(d)	1. more gonadotropins ; 2. {use / muscle uptake} of (excess) fatty acids ; 3. respired to release (much) energy / increased fat metabolism ; 4. idea of reduced requirement to replenish glycogen stores ;	**(3)**

Question Number	Answer	Mark
(e)	1. (slow twitch muscles) carry out aerobic respiration / full oxidation / eq ; 2. which produces more ATP (than anaerobic) / eq ; 3. 'energy' not locked up in lactate / eq ; 4. idea that it takes longer for lactate levels to build up ;	**(2)**

Question Number	Answer	Mark
***(f)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence) 1. Ca^{2+} leaks out of {cell / *cytoplasm* / *sarcoplasmic reticulum*} ; 2. idea of change in Ca^{2+} binding to *troponin* ; 3. causes displacement of *tropomyosin* / eq ; 4. idea of change in number of *myosin* binding sites exposed ; 5. comment on *myosin* binding to *actin* ; 6. (loss of Ca^{2+} from cell / cytoplasm) therefore force exerted by muscle is lower than expected OR (more Ca^{2+} in cytoplasm) results in less ATP so less muscle contraction ;	**(4)**

Question Number	Answer	Mark
(g)	**Process** / **Two nucleic acids involved in the process** Transcription of the ACE gene / DNA & mRNA ; Production of ACE at a ribosome / Any **two** from: mRNA, tRNA, rRNA ;	**(2)**

Question Number	Answer	Mark
(h)	1. obtain a sample of cells / extract DNA (from cells) ; 2. reference to named enzyme ; 3. idea of how to increase amount of DNA ; 4. reference to electrophoresis ; 5. details of electrophoresis ; 6. use a {DNA / gene} probe ; 7. with a base sequence complementary to that on the {variant / eq} ; 8. idea of matching with known variant profile ;	**(4)**

Question Number	Answer	Mark
(i)	B ;	**(1)**

Question Number	Answer	Mark
(j)	1. (higher metabolic rate) means more chemical reactions / eq ; 2. more {energy released / ATP used} / eq ; 3. (which) releases heat / eq ; 4. keeps divers warmer / warm for longer / able to swim without a wetsuit / eq ;	**(3)**

Question Number	Answer	Mark
(k)	1. carbon dioxide due to {deforestation / land cleaning / burning fossil fuels / correct ref to respiration / eq} ; 2. methane from {rice fields / anaerobic bacterial action / ruminant fermentation / named ruminant} ;	**(2)**

Question Number	Answer	Mark
(l)	1. 1.4 ÷ 37 = ; 2. 3.8 (%) ; Correct answer gains both 2 marks	**(2)**

Q5.

	Answer	Mark
(i)		(2)

Investigation	Type of respiration	Potassium hydroxide solution absent or present	Coloured liquid moved to the left	Coloured liquid moved to the right	Coloured liquid did not move
1	Anaerobic	Absent	☒	☒	☒
2	Aerobic	Absent	☒	☒	☒ ;
3	Aerobic	Present	☒ ;	☒	☒

Question Number	Answer	Additional Guidance	Mark
(ii)	1. (as anaerobic) no O_2 absorbed / eq ; 2. no CO_2 produced / eq ; 3. so no change in {volume/pressure} (so liquid does not move) ; 4. since for each 6C glucose respired, 2x3C lactate formed / eq ;	1. **ACCEPT** No oxygen used	(3)

Question Number	Answer	Additional Guidance	Mark
(iii)	1. (reduced NAD from glycolysis) enters mitochondria/ moves through outer mitochondrial membrane / eq ; 2. moves to inner membrane of mitochondrion / eq ; 3. becomes {oxidised /NAD / NAD^+} ; 4. as {electrons / eq} transferred to {electron transport chain / eq} / eq ; 5. fate of hydrogen ions described e.g. pumped into membrane space ; 6. (NAD) returns to {Krebs cycle/ matrix / eq} ;	**2. ACCEPT** crista for inner mitochondrial membrane **6. ACCEPT** cytoplasm, glycolysis	**(4)**

Q6.

Question Number	Answer	Additional Guidance	Mark
	1. (signals are) {calcium ions / Ca^{2+}} ; 2. less (Ca^{2+}) binding to troponin so less tropomyosin {displaced / eq} ; 3. so less myosin binding sites exposed (on actin) / less myosin binds (to actin) ; 4. so there is a lack of muscle use / eq ; 5. idea that muscle atrophy means muscle (mass) reduction	5. **ACCEPT** muscle wastage for muscle reduction	**(4)**

Q7.

Question Number	Answer	Mark
(i)	An explanation that makes reference the following: • anaerobic respiration takes place (1) • therefore {lactic acid / lactate} is produced (1) • because pyruvate reduced / NADH oxidised / NADH converted to NAD^+ / NADH donates H^+ or proton or e^- (1)	**(3)**

Question Number	Indicative content
*(ii)	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. **Description: D** shape of curve is sigmoid / S-shaped tadpole curves are steeper tadpole curves are further to the left than frog curves lower pH moves curve to left in tadpole lower pH moves curve to the right in frog tadpole curves are closer together than frog curves reference to correct comparative % ONCE **Explanation: E** at higher ppO_2 blood more saturated / as ppO_2 increases saturation increases at lower ppO_2 blood less saturated / as ppO_2 decreases saturation decreases tadpole is more saturated at lower ppO_2 tadpole more dissociation with change in $pp0_2$ tadpole has higher % saturation than frog tadpole blood has greater affinity than blood movement lowers pH in blood Bohr shift in frog conformational change makes binding easier steep part of curve means small change in ppO_2 causes large change in percentage saturation top part of curve represents situation in gills or lungs bottom part of curve represents situation in tissues **Habitat: H** less oxygen in water than in air / ppO_2 in water lower than ppO_2 in air (lowering pH) tadpole is more able to obtain oxygen from polluted water (lowering pH) frog more able to release oxygen to tissues during exercise / activity / movement adaptations allow tadpole / frog to survive harder to move in water than on land

Level	Marks	
0	**0**	No awardable content
1	**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 to 3 from D, E or H**
2	**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. **1H and 4 to 6 in total**
3	**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. **2H and 7 to 9 plus in total**

Q8.

Question Number	Answer	Additional Guidance	Mark
(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 **IGNORE** NAD otherwise	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(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)	**ACCEPT** no oxygen **IGNORE** numbers of ATP molecules produced	(4) EXP

	• ATP is produced (directly / SLP) during glycolysis (during these anaerobic conditions) (1)		

Question Number	Answer	Additional Guidance	Mark
(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** **IGNORE** any explanations given	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(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) EXP