PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 5: ENERGY FOR BIOLOGICAL PROCESSES

GLYCOLYSIS

SCORE	PERCENTAGE
/84	%

STEMUP

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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	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)**

Q3.

	Answer	Mark
(i)	<table><tr><th>Investigation</th><th>Type of respiration</th><th>Potassium hydroxide solution absent or present</th><th>Coloured liquid moved to the left</th><th>Coloured liquid moved to the right</th><th>Coloured liquid did not move</th></tr><tr><td>1</td><td>Anaerobic</td><td>Absent</td><td>☒</td><td>☒</td><td>☒</td></tr><tr><td>2</td><td>Aerobic</td><td>Absent</td><td>☒</td><td>☒</td><td>☒ ;</td></tr><tr><td>3</td><td>Aerobic</td><td>Present</td><td>☒ ;</td><td>☒</td><td>☒</td></tr></table>	(2)

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)**

Q4.

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)**

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	• {fewer / smaller} cristae / less folding of the inner membrane / reduced surface area of inner membrane		(1)
(ii)	An explanation that makes reference to two of the following: • (fewer cristae / lower surface area) therefore reduced electrontransport chain (1) • because ribosomes prevented from synthesising {enzymes / ATPase / electron transport molecules} (1) • credit reason linked to protein not made (1)	e.g. no enzymes to catalyse steps in Krebs cycle, noATPase channels for {protons to pass through / phosphorylation of ADP}, no ETC so no redox reactions **ACCEPT** less intermembrane space foraccumulation of protons = 1 mark	(2)
(iii)	An explanation that makes reference to the following: • no ATP will be produced (if both inhibited / glycolysis inhibited) (1) • therefore no {energy / ATP} for metabolic process / named metabolic processes / cell division} (1)		(2)

Q6.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	C		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)	B		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(c)	C		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(d)	A description that makes reference to the following: • it is transported into the (matrix) mitochondria (1) • link reaction oxidises pyruvate to form NADH + H^+ (1) • carbon dioxide is removed (1) • molecule combines with acetyl CoA to form coenzyme A (1)		**(4)**

Q7.

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

Q8.

Question Number	Acceptable Answer	Additional guidance	Mark
(i)	B (Krebs cycle)		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(ii)	B (5%)		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(iii)	A description that makes reference to the following: • glucose is phosphorylated using ATP (1) • this product is converted into glycerate 3-phosphate (GP) (1) • GP converted to pyruvate producing reduced NAD (NADH) and ATP (1)		**(3)**

Q9.

Question Number	Answer	Mark
(i)	The only correct answer is **B** matrix **A** is incorrect because only glycolysis takes place in the cytoplasm **C** is incorrect because stroma is in chloroplasts not mitochondria **D** is incorrect because tonoplasts are in plant cells only	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • in anaerobic conditions, the pyruvate is used to reoxidise NADH so no Krebs cycle (1) • no oxygen available to act as a (terminal) electron acceptor (1) • so reduced { NAD / FAD / coenzyme} cannot be reoxidised (1) • so no (oxidised) coenzyme to bind {hydrogen ions / protons / H^+/electrons} (1)	**ACCEPT** oxygen binds to electrons **ACCEPT** NADH / $FADH_2$	(3)