Question Number	Answer	Additional Guidance	Mark
1(a) (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
1(a)(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
1(a)(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)

Question Number	Answer	Additional Guidance	Mark
1(b)	1. same mass of each tissue / eq ; 2. idea of time being recorded for {a set distance travelled by coloured liquid OR distance coloured liquid travelled in a set time} ;	1. **GNORE** amount	(2)

Question Number	Answer	Additional Guidance	Mark
2(a)	1. mice of different mass / eq ; 2. idea of concentration is a controlled variable ; 3. idea of increases validity of investigation or conclusions ; 4. maybe harmful in high doses / eq ;	ACCEPT converse statement where appropriate 1. IGNORE ref to diff sizes unqualified 2. to overcome effect of {lighter mice receiving proportionately a higher dose / heavier mice receiving proportionately a lower dose} / to keep concentration per kg of mouse constant ; 3. ACCEPT so comparisons can be made 4. ACCEPT concentration for dose	(3)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	1. increases the ratio; 2. by { 0.3 / 17.6%} ; 3. inner membrane is larger / eq ;	1. ACCEPT ratio is higher 2. ACCEPT 18% 3. ACCEPT increases the surface area of inner membrane ACCEPT converse IGNORE it is smaller	(2)

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	1. idea that fatigue may be due to less ATP ; 2. inner membrane is the site of {electron transport chain / oxidative phosphorylation / eq} ; 3. {more inner membrane / greater inner surface area} then more electron transport chain / eq ; 4. more ATP made / eq ; 5. detail of ATP synthesis e.g. ref to chemiosmosis, H^+ down electrochemical gradient through ATP synthase ; 6. (so) delays onset of fatigue / eq ; 7. by 34 seconds in {group A / those fed epicatechin} ;	ACCEPT converse where appropriate 1. ACCEPT running out, running short 2+3 ACCEPT crista for inner membrane 3. ACCEPT more aerobic respiration 4. ACCEPT idea that more ATP present/available 5. This mp is independent of quantity 6. ACCEPT ref to muscles can contract for longer 7. gains Mp6 as well if states comparison e.g. 34s longer to fatigue	(5)

Question Number	Answer	Additional guidance	Mark
3(a)	1. Mean time for group A much longer (compared with B) / eq ; 2. No overlap of data / eq ; 3. Idea that means for {B and C / eq} very close together ; 4. Range of data both overlap (for B and C) ; 5. Manipulated data used e.g. lowest time for group A is 154 sec and still higher than longest time for group B (@ 134 sec) or C (@ 133 sec) ;		**(4)**

Question Number	Answer	Additional guidance	Mark
3 (b)(i)	4. Increases / eq ; 5. by {50% / 0.6 / 1.5x} ;		**(2)**

Question Number	Answer	Additional guidance	Mark
*** 3 (b)(ii)**	(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. Idea that fatigue maybe due to less ATP ; 2. more *capillaries* supplies more *blood* / eq ; 3. idea of more *capillaries* gives greater surface area for exchange ; 4. this supplies {*oxygen* / *glucose* / *eq*} ; 5. for *aerobic* respiration / eq ; 6. Detail of *aerobic* respiration ; 7. (so) more ATP *made* / eq ; 8. (so) delays onset of fatigue / eq ; 9. By 34 seconds in {group A / those fed on epicatechin} ;	QWC emphasis is spelling 1. ACCEPT running out /running short 6. ACCEPT a description e.g. of oxidative phosphorylation 7. ACCEPT idea that more ATP present/available 8. ACCEPT ref to muscles can contract for longer 8. gains mp7 as well if states comparison e.g. 34s longer to fatigue	**(5)**

Question Number	Answer	Additional guidance	Mark
4(a)	1. Idea an enzyme converts a named substrate into named product e.g. enzyme 1 converts P to Q ; 2. idea that this product becomes the substrate of next step ; 3. idea of specificity ; 4. {controls / eq} the conversion / eq ; 5. speeds up the conversion / eq ; 6. by reducing activation energy / eq ; 7. credit reference to control of whole process ;	ACCEPT answers in context of respiration ACCEPT 1 - ref to an enzyme converting one named intermediate to the next e.g.{enzyme/ named enzyme} used to convert hexose to phosphorylated hexose ACCEPT 3 - description of specificity e.g. active site of enzyme 1 only accepts substance P or in context of named respiratory intermediate ACCEPT 4 – regulates ACCEPT 5 - catalysis / enzyme acts as a catalyst ACCEPT 7 - end product inhibition or description	**(4)**

Question Number	Answer	Additional guidance	Mark
4(b)(i)	1. W = {NAD / NAD^+ / NAD_{ox} / eq} ; Any two of the following: 2. (due to) reduced NAD {releasing/eq} {electrons / eq} ; 3. Idea of electrons go to {carrier A / ETC / eq} ; 4. idea of H^+ moved into inter-membranal space ;	ACCEPT 2 – being oxidized Releasing hydrogen (atoms), H^+/protons $^-$ ACCEPT 3 – 1st electron carrier/correctly named carrier	**(3)**

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	1. substance **X** is ATP ; Any two of the following : 2. due to H^+ pass through {stalked particle / ATP synthase} ; 3. (H^+ passes) down an electrochemical gradient ; 4. (sufficient) energy is {released / eq} ; 5. to join ADP and {Pi / eq} ; 6. reference to chemiosmosis ;	ACCEPT 2 –ATPase ACCEPT 3 - description of electrochemical gradient ACCEPT 5 – phosphorylation of ADP	**(3)**

Question Number	Answer	Additional guidance	Mark
4(c)			**(3)**

Situation	**Movement of coloured liquid**		
	towards A	**towards B**	**does not move**
Screw clip is open			☒
Screw clip is closed	☒		
Potassium hydroxide is replaced with water and screw clip is closed			☒