

Respiration

Mark Scheme 4

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Energy and respiration
Sub Topic	Respiration
Booklet	Theory
Paper Type	Mark Scheme 4

Time Allowed : 66 minutes

Score : / 55

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 (a) (i) removal of, carbon dioxide/carboxyl group ; [2]
removal of hydrogen ;
- (ii) P and Q ; [1]
- (b) (i) 3 ; [1]
- (ii) 1 inner mitochondrial membrane/cristae ;
2 dehydrogenase enzymes ;
3 release hydrogen ;
4 hydrogen splits into protons and electrons ;
5 electrons flow down, ETC/Electron Transfer Chain/AW ;
6 energy released ;
7 protons pumped across (inner membrane) ;
8 into intermembrane space ;
9 proton gradient ;
10 protons pass through, ATP synthase/stalked particles ;
11 ATP formed ; *linked to 10*
12 oxygen (final), hydrogen/proton and electron, acceptor ; max 4 [5 max]
- (c) 1 pyruvate converted to ethanal ;
2 ethanal reduced ;
3 by reduced NAD ;
4 NAD, oxidised/regenerated ;
5 allows glycolysis to continue ;
6 ethanal dehydrogenase ;
7 ethanol formed ;
8 prevents H⁺ from lowering pH ; [4 max]

(d) 1 no, decarboxylation/carbon dioxide removed ; **A** ora

2 single step ;

3 lactate dehydrogenase ;

4 reversible ;

[3 max]

[Total: 16]



2 (a) (i) 18 ; [1]

(ii) 0.72 ;

allow ecf from (i) [1]

(b) 1 RQ value falls steeply, initially / 40–80 min ;

2 then, very little change / AW ;

3 sugar / carbohydrate, metabolised at start ; **A** named carbohydrate

4 then fat metabolised ;

5 (due to) fasting / carbohydrate running out ; [4 max]

(c) 1 increase in rate of respiration ;

2 kinetic energy increases / more enzyme-substrate complexes / enzyme activity increases ;

3 effects of too high a rise in temperature ; e.g. denaturation of enzymes

4 AVP ; e.g. $Q_{10} = 2$ [2 max]

[Total: 8]

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- 3 (a)
- 1 reduced, NAD / FAD ;
 - 2 passed to ETC ;
 - 3 inner membrane / cristae ;
 - 4 hydrogen released (from reduced, NAD / FAD) ; **R** H₂
 - 5 split into electrons and protons ;
 - 6 protons in matrix ;
 - 7 electrons pass along, carriers / cytochromes ;
 - 8 ref. redox reactions ;
 - 9 ref. energy gradient ;
 - 10 energy released ; **R** produced
 - 11 protons (pumped) into intermembrane space ;
 - 12 proton gradient ;
 - 13 protons pass through (protein) channels ;
 - 14 ATP synthase / stalked particles ;
 - 15 ATP produced ;
 - 16 chemiosmosis ;
 - 17 electron transferred to oxygen ;
 - 18 addition of proton (to oxygen) to form water / (oxygen) reduced to water ; [9 max]

if candidate mistakenly writes about photosynthesis only allow marking points 7, 8, 9, 10 and 15 to 5 max

- (b) *in cytoplasm*
- 19 NAD, becomes reduced / accepts H ;
 - 20 during glycolysis ;

in plants

- 21 pyruvate converted to ethanal ;
- 22 ethanal reduced ;
- 23 by reduced NAD ;
- 24 ethanol formed ;

in animals

- 25 pyruvate converted to lactate ;
- 26 by reduced NAD ;
- 27 in, liver / muscles ;
- 28 allows glycolysis to continue ; [6 max]

allow either 23 or 26

[Total: 15]

process	products
glycolysis	ATP ; pyruvate ; reduced NAD ;
Krebs cycle	ATP ; reduced NAD / reduced FAD ; CO ₂ ;
oxidative phosphorylation	ATP ; water ; NAD / FAD ;

R NADP throughout

[8 max]

[Total: 8]

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Question	Answers	Marks
5 (a)	cytoplasm ;	[1]
(b)	hexose bisphosphate / phosphorylated 6C sugar / fructose bisphosphate ;	[1]
(c)	hexose energy rich ; does not react easily / AW ; phosphorylation activates hexose ; maintains concentration gradient of glucose inside and outside cell ;	[2 max]
(d)	does not enter Krebs cycle ; decarboxylated / CO ₂ released ; forms ethanal ; reduced / ref: reduced NAD ; to ethanol ; reduced NAD does not enter ETC ; ref: alcohol dehydrogenase ; irreversible ;	[4 max]
		[Total: 8]

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