

# Respiration

## Mark Scheme 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Energy and respiration
Sub Topic	Respiration
Booklet	Theory
Paper Type	Mark Scheme 5

Time Allowed : 70 minutes

Score : / 58

Percentage : /100

Grade Boundaries:

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

**Question****Marks**

- 1 (a) a nucleotide ;  
with three phosphate groups ;  
an organic / nitrogenous base / adenine ;  
a pentose sugar / ribose ;  
ref. ester linkages / covalent bonds ; **3 max**
- (b) synthesized from ADP and  $P_i$  ;  
soluble molecule ;  
diffuses rapidly / transported easily ;  
on hydrolysis / removal of (third) phosphate ;  
energy released /  $30.5 \text{ kJ (mol}^{-1}\text{)}$  ;  
ref.(idea) intermediary (between energy yielding and energy requiring reactions) ; **3 max**
- (c) oxidative phosphorylation ;  
 $\text{NADH}_2$  to, cristae / inner membrane ;  
oxidised to NAD ;  
ref. transfer of electrons to electron carriers / ETC ;  
 $\text{H}^+$  pumped into intermembrane space ;  
ref. to  $\text{H}^+$  gradient ;  
 $\text{H}^+$  (diffuses) through ATP synthase / stalked particle ;  
results in ADP and  $P_i$  to ATP ;  
ref. chemiosmosis ;  
ref. substrate level phosphorylation ; **4 max**

**Total: 10**

Question	Expected Answers	Marks
2 (a)	<p><b>A</b> microvilli / brush border ;</p> <p><b>B</b> invagination / infolding of membrane / basal channels ;</p>	2
(b)	<p>basal channels / microvilli / brush border – increase surface area ;</p> <p>many mitochondria – provide ATP for active transport ;</p> <p>carrier proteins / cation pumps in csm – active uptake / facilitated diffusion / co-transport ;</p> <p>tight junctions – prevent migration of membrane proteins / separate tubule fluid ;</p> <p>ref. to pinocytosis – protein uptake ;</p>	3 max
(c)	<p><math>\text{Na}^+</math> actively transported (out of cell) into blood ;</p> <p>creates concentration gradient ;</p> <p><math>\text{Na}^+</math> enters cell by diffusion ;</p> <p>through cotransporter / symporter proteins ;</p> <p>glucose cotransported / facilitated diffusion (from lumen to cells) ;</p> <p>glucose diffuses into blood capillaries ;</p>	3 max
(d)	<p>proximal convoluted tubule cells have a low / more negative water / solute potential ;</p> <p>due to high concentration of salts / ions / glucose / <math>\text{Na}^+</math> ;</p> <p>water enters by osmosis ;</p> <p>down water potential gradient (idea) ;</p>	2 max
		<b>Total: 10</b>

3 (a) contains ribose (not deoxyribose) ;

has three phosphate groups (not one) ;

[2]

(b) (i) *anaerobic – accept **ora** for aerobic*

1 *idea that* glucose not completely, broken down / oxidised

**or**

only glycolysis occurs ;

2 pyruvate / lactate / ethanol, still contains energy ;

3 ETC stops ;

4 (because) no oxygen to act as (final) electron acceptor ;

5 (so) no, Krebs cycle / link reaction / oxidative phosphorylation / chemiosmosis ;

[max 3]

(ii) 1 lipid contains (relatively) more, hydrogen atoms / C-H ;

2 detail ; e.g. molecular formula of glucose and a lipid given

3 more reduced, NAD / FAD, produced ;

4 more electrons passed along ETC ;

5 more hydrogen ions pumped across inner mitochondrial membrane / more hydrogen ions pumped into intermembrane space / steeper proton gradient ;

[max 3]

**[Total: 8]**

- 4 (a) adenine / nitrogen(ous) base / purine ; **R** adenosine  
ribose / pentose ;

[2]

- (b) 1. (cell uses) ATP as source of energy ;  
2. ATP broken down ;  
3. (so) cell must regenerate ATP ;  
4. from ADP and P ;  
5. ref. ADP / AMP, must be synthesised in the cell ;

[max 2]

- (c) (i) 1. palmitic acid has **more**, hydrogens / C-H bonds ;  
2. per mole ;  
3. hydrogens needed for, ATP production / chemiosmosis / oxidative phosphorylation ;

[max 2]

- (ii) *alanine* – starvation / lack of fat or carbohydrate ;  
*lactate* – after anaerobic respiration ;

[2]

**[Total: 8]**

CHEMISTRY ONLINE  
— TUITION —

- 5 (a) 1. oxidative phosphorylation ;  
2. oxygen is **final** electron acceptor ;  
3. reduced to water / accepts hydrogen ion to form water    **A** equation  
4. so electron transport chain can continue    ora  
5. increases ATP production    ora  
6. in absence of oxygen only glycolysis continues ;

[max 3]

- (b) (i) 1. lipid releases most energy ;  
2. because it has more, hydrogens / C-H bonds  
3. per unit mass ;  
4. hydrogens needed for, ATP production / chemiosmosis

[max 3]

- (ii) many more hydrogens available to, reduce / convert, oxygen to water ;

[1]

**[Total: 7]**

CHEMISTRY ONLINE  
— TUITION —

- 6 (a) **X** = crista(e) / inner membrane ;  
**Y** = matrix ; [2]
- (b) (i) raise chemical PE of glucose / provide activation energy / AW ; [1]  
(ii) removes hydrogen / hydrogen carrier / coenzyme ; [1]  
(iii) 4 ; **A** net 2 [1]  
(iv) dehydrogenation ; **A** oxidation  
decarboxylation ;  
*accept 'oxidative decarboxylation' for two marks* [2]  
(v) matrix ; [1]  
(vi) 1. accepted by NAD ;  
2. passed to ETC ;  
3. for oxidative phosphorylation ;  
4. ref. proton pump / chemiosmosis ; [2 max]
- (c) 1. found in all organisms ;  
2. loss of phosphate / hydrolysis, leads to, energy release /  
release of 30.5 kJ (per mole) ;  
3.  $\text{ADP} + \text{P}_i \rightleftharpoons \text{ATP}$  / reversible reaction ;  
4. small packets of energy ;  
5. small / water soluble, so can move around cell ;  
6. (used by cells as) immediate energy donor ;  
7. link between energy yielding and energy requiring reactions / AW ;  
8. high turnover ;  
9. example of use ; e.g. active transport / muscle contraction / Calvin cycle /  
protein synthesis [5 max]

[Total:15]

CHEMISTRY ONLINE  
— TUITION —