

## 5.2 Energy transfers in and between organisms (A-Level Only) – Respiration 2– Mark schemes

### Q1.

- (a) (Absorption of) light; 1
- (b) Inner membrane / cristae / stalked particles of mitochondria; 1
- [2]**

### Q2.

- (a) 

✓	✓	x;
x	x	✓;
✓	✓	✓
✓	x	x

4
- (b) (i) pyruvate / succinate / any suitable Krebs cycle substrate; 1
- (ii) ADP and phosphate forms ATP;  
oxygen used to form water / as the terminal acceptor; 2
- (iii) Y X W Z;  
order of carriers linked to sequence of reduction / reduced carriers cannot pass on electrons when inhibited; 2
- [9]**

### Q3.

- (a) matrix; 1
- (b) pyruvate;  
ADP;  
P / inorganic phosphate;  
reduced NAD;  
oxygen; 2 max
- (c) larger surface area for electron carrier system / oxidative phosphorylation; provide ATP / energy for contraction; 2
- [5]**

### Q4.

- (a) X = Carbon dioxide;  
Y = Acetyl coenzyme A;  
*(ACCEPT Acetyl CoA)*  
  
Z = Water; 3

- (b) (i) Cytoplasm; 1
- (ii) Mitochondrion;  
(*IGNORE named part*) 1

(c) On the diagram:

- (i) 'A' (ATP used) – between glucose and triose phosphate; 1

- (ii) 'B' Any two from:

(ATP produced) – between triose phosphate and pyruvate;  
in Krebs cycle;  
from electron carriers  
(to right of bracket & not below grey box);

max 2

(d) Any three from:

Source of energy / of phosphate;  
Active transport;  
Phagocytosis / endo- / exocytosis / pinocytosis;  
Bile production;  
Cell division / mitosis;  
Synthesis of: glycogen;  
protein / enzymes;  
DNA / RNA;  
lipid / cholesterol;  
urea;

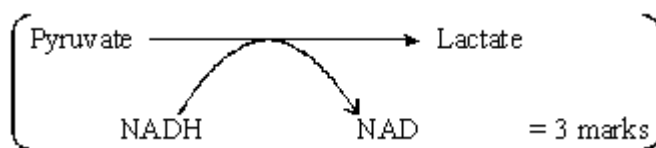
max 3

(e) Any four from:

Forms lactate; [extras –  $C_2H_5OH$  /  $CO_2$  – *CANCEL*]

Use of reduced NAD / NADH;

Regenerates NAD;



NAD can be re-used to oxidise more respiratory substrate / correct e.g. /  
allows glycolysis to continue;  
Can still release energy / form ATP  
when oxygen in short supply / when no oxygen;

max 4

[15]

### Q5.

- (a) (i) ammonia / ammonium ions / compound; 1
- (ii) glucose; 1

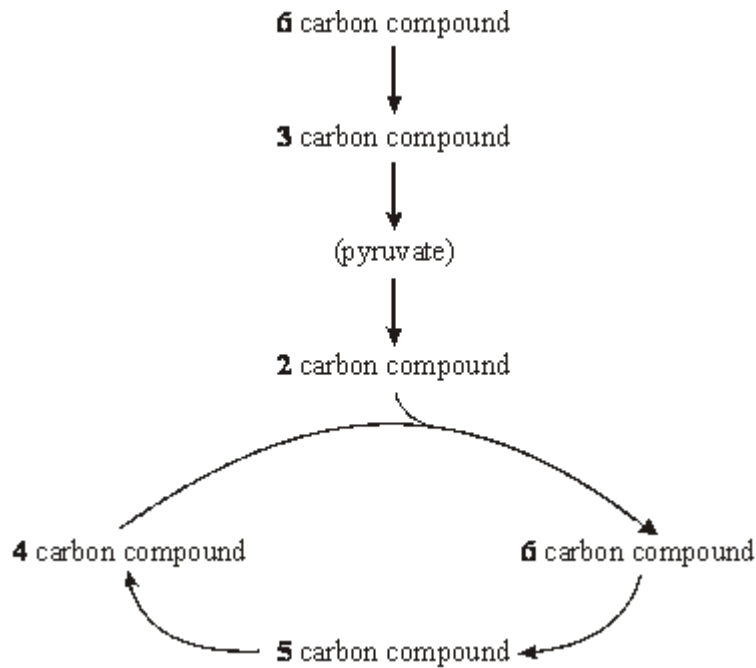
- (b) final acceptor for hydrogen:  
to form water; 2
- (c) glycolysis can continue;  
NAD can accept more hydrogen; 2
- (d) secondary / tertiary structure;  
produces particular shape of active site;  
*or*  
(shape of) active site;  
complementary to shape of substrate; 2
- (e) sodium ions / non-competitive inhibitor binds to enzyme  
at a site other than active site;  
resulting in change of shape of active site / no longer complementary;  
substrate can no longer bind with the enzyme / enzyme-substrate  
complexes no longer formed; 3
- [11]**

**Q6.**

- (a) (i) 29.47(29.5);  
*(2 marks for correct answer)*  
40% / 0.4 of 2800 / 38; 2
- (ii) released as heat; 1
- (b) (i) glucose only partly broken down / only broken down to lactate; 1
- (ii) lactate / lactic acid has built up / been produced;  
oxygen used to break down lactate / convert it back to  
pyruvate / glucose / glycogen; 2
- [6]**

**Q7.**

- (a)



(1 mark for three correct answers)

(2 marks for six correct answers)

2

- (b) reduced NAD / NADH / NADH<sub>2</sub>;  
reduced FAD / FADH / FADH<sub>2</sub>;  
ATP;

3

[5]

**Q8.**

- (a) used in (aerobic) respiration / to provide energy / ATP  
(and not replaced by breathing) / used up by muscle and not replaced;  
(reject used up and used up and not replaced)

1

- (b) 36;

1

- (c) converted back to pyruvate / glycogen / glucose / CO<sub>2</sub> and H<sub>2</sub>O;  
reacted with oxygen / oxidised;  
(reject "breaking down" with respect to glycogen and glucose)

2

- (d) (i) vasoconstriction / contraction of muscles in arteries / arterioles /  
arteries / arterioles close;  
(reject contraction of arteries / arterioles / capillaries)

1

- (ii) supplies oxygen / glucose or removal of carbon dioxide / lactate;  
so cells can respire when not contracting / breathing;

2

[7]

**Q9.**

- (a) (i) in case normal coffee differs in some other way /  
to control concentration of caffeine; 1
- (ii) not telling them what the drink contained / purpose of experiment; 1
- (b) (i) able to continue for longer; (*not just increases performance*)  
(*disqualify if also refers to fatty acids and glycerol*) 1
- (ii) breakdown of fats;  
at increased rate / by mobilisation of fat stores; 2
- (c) (i) idea that volumes of oxygen and carbon dioxide the same;  
reference to equal moles, or quotient as 1 divided by 1 / or 6 by 6; 2
- (ii) glycogen is a carbohydrate / broken down to glucose, linked to RQ;  
with no caffeine, RQ nearer 1.0 / less carbon dioxide exhaled and  
more oxygen inhaled (or vice versa) / with caffeine higher proportion of  
fats / fatty acids respired;  
increased time to exhaustion suggests slower use of glycogen: 3

[10]

**Q10.**

- (a) (i) Cytoplasm (of cell);  
*Accept sarcoplasm/cytosol* 1
- (ii) In membranes/cristae (of mitochondria);  
*Reject matrix of mitochondria* 1
- (b) NO stops uptake/use of oxygen (by cells); 1
- Stops (electron transport chain of) respiration;  
*Accept – stops oxidative phosphorylation* 1
- NO changes shape of protein (in chain); 1
- Oxygen no longer required as final electron acceptor (however stated);  
*Accept – protein denatured or description* 1
- As oxygen conc. gets lower effect of NO lasts longer, because  
NO more likely to interact with protein;  
*Reject accepts hydrogen from etc in 3rd marking point* 1

3 max

[5]

**Q11.**

- (a) (more cristae / larger surface area) for electron transport chain / more enzymes for ATP production / oxidative phosphorylation; muscle cells use more ATP (than skin cells)(not just more respiration); 2
- (b) (i) pyruvate; 1
- (ii) carbon dioxide formed / decarboxylation; hydrogen released / reduced NAD formed; acetyl coenzyme A produced; 2 max
- (c) NAD / FAD reduced / hydrogen attached to NAD / FAD; H<sup>+</sup> ions / electrons transferred from coenzyme to coenzyme / carrier to carrier / series of redox reactions; energy made available as electrons passed on; energy used to synthesise ATP from ADP and phosphate / using ATPase; H<sup>+</sup> / protons passed into intermembrane space; H<sup>+</sup> / protons flow back through stalked particles / enzyme; 3 max

**[8]****Q12.**

- (a) (i) to increase surface area (for carbon dioxide absorption); 1
- (ii) oxygen is used / carbon dioxide emitted is absorbed; so decrease in volume / pressure; 2
- (iii) change of level of (manometer) liquid over time; bore of tube; mass of snails; time interval; 3 max
- (b) (i) *valid similarity taking into account SD e.g. between 5 and 15 °C both show little effect of temperature / intakes similar between 5 and 15 °C;* 1
- valid difference taking into account SD above 15 °C e.g. rise at 20 °C and above is less when snails kept in sea water;* 1
- (ii) standard deviations high; means unreliable; *(accept 25 °C being out of normal range for snail / not enough temperature readings for 1 mark)* 2

**[10]****Q13.**

- (a) (i) Cytoplasm;  
*Accept - cytosol*

1

(ii) Inner membrane of mitochondrion / cristae;

*Reject – crista/ particle*

1

(b) Oxygen is the terminal acceptor;  
(No) electron transfer chain / proton transfer / no oxidative phosphorylation;

*Accept ETC abbreviation*

Which produces most of the ATP (in aerobic respiration);

Only glycolysis takes place;

Pyruvate used to make lactate;

*Accept lactic acid*

Only produces (net) 2 ATP (per molecule of glucose);

*Accept only 4 ATP are made*

2 max

[4]

