

- M1.** (a) (i) 1. Oxygen taken up/used (by woodlouse);
2. Carbon dioxide (given out) is absorbed by solution/potassium hydroxide;
3. Decrease/change in pressure;
Reference to vacuum negates last marking point
Reject reference to pressure increasing inside tube 3
- (ii) 1. Distance (drop moves) and time;
2. Mass of woodlouse;
3. Diameter/radius/bore of tubing/lumen/cross-sectional area;
If answer refers to measuring volume using the syringe allow 2 max –
one mark for measuring volume;
one mark for mass of woodlouse; 3
- (b) 1. Less/no proton/H⁺ movement so less/no ATP produced;
2. Heat released from electron transport/redox reactions/energy not used to produce ATP is released as heat;
3. Oxygen used as final electron acceptor/combines with electrons (and protons); 3

[9]

- M2.** (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;

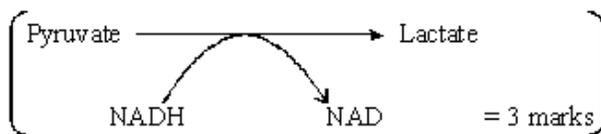
max 3

(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]

- M3.** (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]

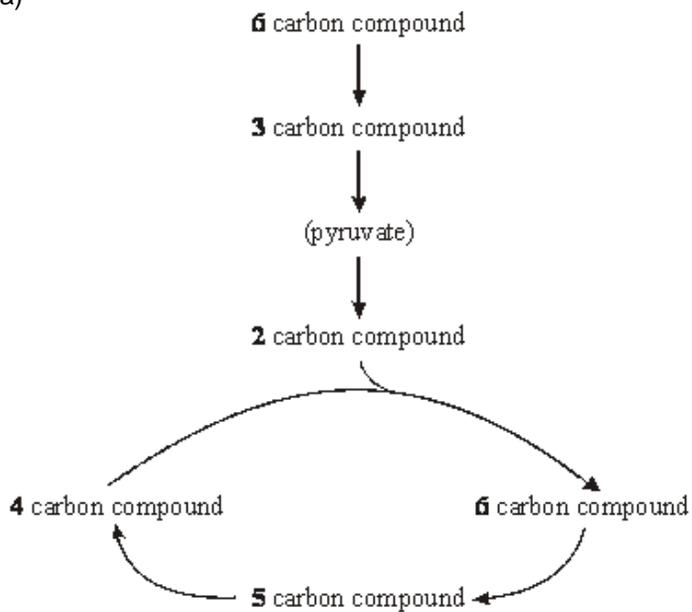
- M4.** (a) (i) glycolysis; 1
- (ii) oxygen removed from pyruvate/ reduced NAD is oxidised/
donates hydrogen/donates electrons; 1
- (iii) allows NAD to be recycled/re-formed;
so that glycolysis/described/ candidates answer to (i) can proceed/
so that (more) glucose can be
converted to pyruvate/so that process X can continue; 2
- (b) (i) ATP formed/used;
pyruvate formed/reduced;
NAD/reduced NAD;
glycolysis involved/two stage process; 2 max
- (ii) ethanol/alcohol formed by yeast, lactate (*allow lactic acid*)
by muscle cell; CO₂ released by yeast but not by muscle cell;
(note: need both parts of the comparison for the mark) 2
- (c) (i) allows anomalies to be identified/increases reliability (of means/
averages/results);
allows use of statistical test; 2
- (ii) $\frac{38.3 + 27.6 + 29.4}{3} = 31.8 / 31.76 / 31.77;$
(units not required)
 $\div (5 \times 60) = 0.106 / 0.11 / 0.1;$
(correct answer scores two marks, however derived.)
(correct mean volume (31.8 cm³) however derived scores 1 mark) 2

- (iii) Volume(s) less/ no gas evolved;
 Glucose has RQ of 1.0;
 So (volume) CO₂ evolved = (volume of) O₂ taken in;

3

[15]

M5. (a)



(1 mark for three correct answers)
 (2 marks for six correct answers)

2

- (b) reduced NAD/NADH/NADH₂;
 reduced FAD/FADH/FADH₂;
 ATP;

3

[5]

M6.

- (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]

- M7.** (a) Electrons transferred down electron transport chain;
Provide energy to take protons/H⁺ into space between membranes;
Protons/H⁺ pass back, through membrane/into matrix/through
ATPase;
Energy used to combine ADP and phosphate/to produce ATP;
Accept: alternatives for electron transport chain. 3 max

- (b) (i) Prevent damage to mitochondria caused by
water/osmosis/differences in water potential;
Accept: other terms that imply damage e.g. shrink/burst 1

- (ii) Glucose is used/broken down during glycolysis;
Breakdown of glucose/glycolysis in cytoplasm/not in mitochondria;
*Accept: 'glucose is converted to pyruvate' for description of
breakdown*
Glucose cannot cross mitochondrial membrane/does not
enter mitochondria;
Accept: only pyruvate can 2 max

- (iii) Terminal/final acceptor (in electron transport chain)/used to
make water;
Could be shown by symbols 1

[7]

- M8.** (a) (i) 2 (molecules) 1
- (ii) Cannot pass out of cell;
Quickly/easily broken down (hydrolysed) / broken down in a on-step reaction / immediate source of energy;
Stores / releases small amounts of energy;
Do not credit "producing energy" max 2
- (b) Formed when reduced NAD used to reduce / donate H ions to pyruvate / convert pyruvate to ethanol; 1
- (c)
$$\text{R.Q.} = \frac{\text{amount CO}_2 \text{ produced}}{\text{amount O}_2 \text{ used}};$$
 Anaerobic respiration occurring;
 Produces CO₂ but doesn't use O₂ / more CO₂ produced than O₂ used; max 2
- [6]**
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- M9.** (a) (i) **P** = 3;
Q = acetylcoenzyme A; 2
- (ii) 36 ATP, however derived = 2 marks
30 ATP, however derived = 1 mark 2
- (iii) *Correct statement in the context of aerobic respiration or anaerobic respiration concerning:*
Oxygen as terminal hydrogen/electron acceptor;
Operation of electron transport chain/ oxidative phosphorylation;
Fate of pyruvate;
Krebs cycle;
Significance of ATP formed in glycolysis; max. 3
- (b) (i) Thick walls exclude oxygen;
Produced by photosynthetic cells (of fern and *Anabaena*);
Contain no chlorophyll so do not photosynthesise;
Do not produce oxygen;
Oxygen would inhibit nitrogen fixation process; max. 3

- (ii) Decomposers/ bacteria/fungi/saprobionts (in fields);

Convert protein/organic nitrogen (in cells of fern) into ammonium ions (*allow ammonia*);

Ammonium ions (ammonia) converted to nitrite;

Nitrite converted to nitrate;



By nitrifying bacteria / correctly named;

Nitrate used to form protein / amino acids in rice;

Link between application of fern and protein/cells of rice;

Decomposers respire (suitable substrate) and release CO_2 ;

Used in photosynthesis by rice;

max. 5

[15]

- M10.** (a) Krebs cycle/link reaction/pyruvate to acetylcoenzyme A;

Q *Accept valid alternative for any of these steps.*

1

- (b) (Respiratory reactions controlled by) enzymes;

Rate decreases as less kinetic energy/fewer collisions (between substrate and active site) fewer E-S complexes formed;

2

- (c) Requires hydrogen/electrons/is reduction;

Hydrogens from reduced NAD/reduced NAD reduces (pyruvic acid)/reduced NAD oxidised;

Information may be on diagram

2

- (d) Respiring anaerobically;

(Anaerobic respiration/respiration with nitrogen) less efficient/produces less ATP;

More anaerobic respiration/more glucose/substrate must be respired to produce same amount of ATP (so more carbon dioxide produced);

3

[8]

- M11.** (a) pyruvate; 1
- (b) Krebs cycle; 1
- (c) ATP formed as electrons pass along transport chain;
oxygen is terminal electron acceptor / accepts electrons from electron transport chain;
electrons cannot be passed along electron transport chain if no O₂ to accept them;
forms H₂O / accepts H⁺ from reduced NAD/FAD / oxidises reduced NAD/FAD; 3 max
- [5]**
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- M12.** (a) Glycolysis;
Glucose and pyruvate/pyruvic acid; 2
- (b) Light-independent reaction;
Ribulose bisphosphate/RuBP and carbon dioxide; 2
- (c) Light-independent reaction;
Triose phosphate and glucose/hexose; 2
Q Do not accept sugar or carbohydrate as alternative for glucose
- [6]**
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- M13.** (a) 1 Sample of ground beetles captured and counted (a);
2 Released and second sample captured;
3 Count total number of beetles (B) and number marked (b);
4 Total population (A) estimated from the relationship $\frac{a}{A} = \frac{b}{B}$;
5 Detail of method e.g. pitfall trap/markings with tippex;
6 Refinement to ensure greater accuracy e.g. large number/markings in position such that does not affect survival; 5 max
- (b) 1 Mowing prevents growth of woody plants;
2 By cutting off growing point;
3 The longer the interval between mowing, the further succession can progress;
4 With frequent mowing diversity of plants will be less;
5 Fewer insect inhabitants/niches available;
Q Since this is an ecological question, use of appropriate ecological terminology is expected. Credit such terms as producer, consumer, habitat, and niche. Do not credit inappropriate terminology such as "places" to live and "fighting for food".
- 5**

- (c)
- 1 Higher carbon dioxide concentration at night/during darkness;
 - 2 Photosynthesis only takes place during light;
 - 3 Photosynthesis removes carbon dioxide and respiration adds carbon dioxide;
 - 4 Respiration taking place throughout 24 hours;
 - 5 Quantitative consideration such as that in plants overall photosynthetic rate greater than respiration rate;
 - 6 Human effect such as additional carbon dioxide from heavy daytime traffic/street lighting could prolong photosynthesis;

5 max

[15]

M14. (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⁺ 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⁺ / protons passed into intermembrane space;
H⁺ / protons flow back through stalked particles/enzyme;

3 max

[8]

