M1. (a) Prevents oxygen being taken up / entering / being absorbed;

Accept: any idea of no contact with oxygen.

Neutral: for anaerobic respiration / anaerobic conditions.

Neutral: prevents entry of air.

Reject: prevents entry of oxygen and another named gas.

1

(b) (i) 0.0155 / 0.016 = 2 marks;;

0.0775 / 0.077 / 0.078 / 0.08 = 1 mark

/ 0.62 = 1 mark

2

(ii) Glucose decreases / is a limiting factor / increase in ethanol / yeast / cells die / toxins build up;

Accept: glucose is used up.

1

(iii) 1. (Stays the) same / level / (relatively) constant;

2. Same volume / amount of oxygen uptake and carbon dioxide release;

Note: if m.p.1 is awarded m.p 2 can be obtained without referring to 'same volume / amount'.

2

(c) 1. Oxygen is final / terminal (electron) acceptor / oxygen combines with electrons and protons;

2. Oxidative phosphorylation / electron transport chain provides ATP;

3. Only glycolysis occurs without oxygen / no Krebs / no link reaction;

2 max

[8]

M2. (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]

M3. (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; CO_2 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)

÷ (5 × 60) = 0.106/ 0.11/ 0.1;

(correct answer scores two marks, however derived.)

(correct mean volume (31.8 cm^3) however derived scores 1 mark)

2

(iii) Volume(s) less/ no gas evolved;
Glucose has RQ of 1.0;
So (volume) CO_2 evolved = (volume of) O_2 taken in;

3

[15]

M4. (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]

M5. (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:

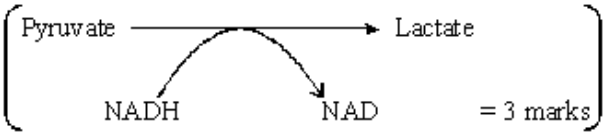
Source of energy/of phosphate;
Active transport;
Phagocytosis / endo- /exocytosis / pinocytosis;
Bile production;
Cell division / mitosis;
Synthesis of: glycogen;
protein / enzymes;
DNA / RNA;
lipid / cholesterol;
urea;

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]

M6. (a) (Absorption of) light;

1

(b) Inner membrane/cristae/stalked particles of mitochondria;

1

(c) Plantae (plants) / Protoctista / prokaryotes;
Processes are photosynthesis and respiration /
plants/algae/(some) protoctistans/prokaryotes photosynthesise/have chlorophyll;

2

[4]

M7. (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;

Allow 1 mark for NH_3 */* $NH_4^+ \rightarrow NO3_3^-$

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]

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 <u>small</u> amounts of energy;
Do not credit "producing energy"

max 2

(b) Formed when reduced NAD used to <u>reduce</u> / donate H ions to pyruvate / convert pyruvate to ethanol;

1

(c) R.Q. = $\frac{amount\ CO_2\ produced}{amount\ O_2\ used}$;

Anaerobic respiration occurring;
Produces CO_2 but doesn't use O_2 / more CO_2 produced than O_2 used;

max 2

[6]

M9. (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 max

[6]

M10. (a) lactate/lactic acid/pyruvate; ATP;

2

(b) (i) energy demand is very high/high respiration rate;
unable to supply enough oxygen to muscles/tissues/cells/
insufficient time for oxygen to reach muscles/tissues/cells /
insufficient oxygen in muscles/tissues/cells;

2

(ii) break down with oxygen /oxidise lactate;
convert to pyruvate / glucose / glycogen / CO_2 + water;
by aerobic respiration;

2 max

[6]

M11. (a) CO_2, water, ATP, reduced NAD/FAD;

(accept creatine phosphate)(any 2 - one tick)

1

(b) (i) build up/increased concentration of lactate;
lowers pH/increases H^+/increases acidity;
enzymes / named protein inhibited(*not denatured);*

2 max

(ii) lactate/pyruvate is an energy source;
muscles have increased/immediate energy or ATP supply;
(accept lactate replenishes glycogen or glucose)
restores pH levels;

2 max

[5]

M12. (a) 0.8;

1

(b) (i) 1. Aerobic respiration;

1. Allow description e.g. respiration using oxygen

1. Accept 'oxidative phosphorylation'

2. Increase in uptake (of oxygen) with growth / reproduction / division of yeast cells;

3. Glucose / nutrients / oxygen decreases / becomes limiting / cells die / ethanol/toxins form / heat produced / anaerobic respiration occurs;

3. Ignore any reference to time

3. Accept decrease in oxygen being linked to oxygen being 'used up' or equivalent

3

(ii) 1. (Ethanol produced) by anaerobic respiration / from pyruvate in anaerobic conditions;

1. 'Fermentation' is not enough on its own

2. (Ethanol / anaerobic respiration) increases as oxygen (uptake / concentration) decreased;

3. Decreases as glucose is used up / ethanol kills cells;

2 max

(c) 1. Oxygen uptake decreases / stopped;

2. Oxygen is final (electron) acceptor / combines with electrons (and protons);

3. Ethanol produced sooner / more ethanol produced;

3. Accept ethanol produced at any specified time before 16 hours

3

[9]

M13. (a) used in (aerobic) respiration / to provide energy / ATP (and not replaced by breathing) / used up by <u>muscle</u> and not replaced;

(reject used up and used up and not replaced)

1

(b) 36;

1

(c) (transported to) the liver / muscles;
converted back to pyruvate/glycogen/glucose/CO_2 and H_2O;
<u>reacted</u> with oxygen / <u>oxidised</u>;

(reject "breaking down" with respect to glycogen and glucose)

2 max

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

(reject contraction of arteries/arterioles/capillaries)

1

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

2

[7]