1. (a) (i) Myosin filaments drawn longitudinally in A-band region;
Actin filaments drawn longitudinally from Z-line to edge of H-zone; 2
[Max. 1 mark if Actin and Myosin are not correctly labelled]

(ii) Electron microscope has greater resolution / able to tell two close objects apart better / electrons have shorter wavelength/higher frequency; 1

(b) Correct answer = 20;
Allow 1 mark for:
$\frac{16 \times 1000}{8000}$;
OR
$40 \div \frac{16}{8000}$ 2

[5]

2. (a) Needed to make ATP / for phosphorylation; 1

(b) (Oxygen) needed for formation of ATP / phosphorylation;
(Oxygen) used (so its level falls);
(Oxygen) reacts (with 'H') to produce water;
In the electron transport chain / at terminal acceptor;
Allows recycling of reduced coenzymes / NAD / FAD; 3 max

(c) Because equal amounts of ADP were added; 1

(d) Less oxygen available in medium at Z than at Y
OR because oxygen all used up / 'runs out'; 1

(e) (i) Glucose cannot enter mitochondria BECAUSE too large to enter / no carrier system for it;
OR glucose cannot be metabolised / equivalent BECAUSE necessary enzymes not present; 2

(*Note single marks here for a suitable suggestion, and for a connected, plausible reason / also that suggestion and reasons may 'cross over'. Allow, each for 2: "*no cytoplasm, no glycosis, not to pyruvate")

(ii) Label glucose and determine its failure to enter mitochondria;
'Break' mitochondrial membrane (to allow entry of glucose);
'Release' appropriate enzymes from mitochondrion;
Add glycolytic enzymes / 'cytoplasm' to medium in advance;
(**OR** suitable suggestions re. possible reason previously given) 1

[9]

3. (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]

4. (a) Anaerobic respiration 1

(b) Increase in the intensity of exercise increases concentration of lactate 1

(c) Athletes are the same gender / use same athlete;
Athletes are same age;
Athletes have similar fitness / body mass;Increase number of athletes /
repeat investigation more gradients;
Control to measure lactate concentration (at rest). max 2

(d) Time required for lactate to diffuse into blood (from muscle) 1

(e) Increase in lactate / lactate produced;
Fall in (blood) pH / increase in hydrogen ions;
Effect on enzymes / muscle proteins. max 2

[7]

5. (a) (i) Water and carbon dioxide/H_2O and CO_2; 1

(ii) Releases energy on breakdown/hydrolysis;
Uses energy from other reactions to form;
Can be readily moved/stored/broken down when needed;
Allows energy to be released in suitable amounts; max 2

(b) (i) RuBP + CO_2 →(2) GP; 1

(ii) RuBP still being produced;
But no carbon dioxide for it to react with/to form GP; 2

[6]

6. (a) Glycogen;
Triglycerides; 2

(a) Decrease in acidity / pH;
Increase in acidity / pH;
Muscle fatigue;
Denaturation / alteration of proteins / enzymes; 2 max

(c) (i) 0.225g (per kilogram of body mass); 1

(ii) Lactate is produced during anaerobic respiration;
Athletes take in more oxygen (at higher intensities of exercise);
Anaerobic respiration delayed / aerobic respiration lasts longer;
Aerobic respiration provides more energy; 3 max

[8]

7. (a) ATP; 1

(b) (i) Lactate lactic acid; 1

(ii) Oxidation / converted to pyruvate; (*Accept., reacts with oxygen, hydrogen removed*)
broken down/used to release energy/ATP;
resynthesis to glucose/glycogen; 2 max

(c) (i) (Almost) entirely anaerobic respiration (under 10s);
no oxygen used in anaerobic respiration / needed from breathing; 2

(ii) Low energy release from anaerobic respiration;
oxygen / glucose not supplied fast enough for (fully) aerobic;

Or build-up of lactate / lactic acid;
causing muscle fatigue / pain / stiffness / disruption of enzymes;

Or glycogen stores used up;
no / slow supply of glucose to replace; 2 max

[8]

8. (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]

9. (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]

10. (a) CO_2, water, ATP, reduced NAD/FAD; 1

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

(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]