

Mark schemes

1	(a) increased speed or harder exercise / running →increased need / use / loss of energy	1	
	<i>allow further you run / walk the more energy you need</i>		
	increased mass / bigger → increased use of energy	1	
	(b) any three from:		
	<ul style="list-style-type: none"> • supply / using (more / enough) oxygen or get (more) oxygen in blood(*) • remove (more) CO₂(*) • doing (more) work or using (more) energy allow produce energy(*) <i>(*)need reference to 'more' ONCE only for full marks</i> • for <u>respiration</u> • prevent build up of lactic acid or prevent oxygen debt or prevent anaerobic (respiration) or allow aerobic (respiration) 	3	
			[5]
2	(a) circulation / mixing / described	1	
	or		
	temperature maintenance		
	supply <u>oxygen</u>		
	<i>do not allow oxygen for anaerobic respiration</i>		
	or		
	for <u>aerobic</u> conditions		
	or		
	for <u>faster</u> respiration	1	

(b) any **one** from:

- energy supply / fuel
or use in respiration
*do **not** allow just food / growth*
ignore reference to aerobic / anaerobic
- material for growth
or to make mycoprotein

1

(c) (heat / energy) from respiration

- allow exothermic reactions*
- allow description eg breakdown of glucose / catabolism*
- ignore metabolism*
- ignore aerobic / anaerobic*

1

(d) (i) any **one** from:

- compete (with Fusarium) for food / oxygen
or reduce yield of Fusarium
- make toxic waste products
or they might cause disease / pathogenic
or harmful to people / Fusarium
*do **not** allow harmful unqualified*

1

(ii) any **two** from:

- steam / heat treat / sterilise fermenter (before use)
***not** just clean*
*allow sterilisation unqualified for **1** mark*
- steam / heat treat / sterilise glucose / minerals / nutrients / water (before use)
***not** just use pure glucose*
- filter / sterilise air intake
- check there are no leaks

2

(e) any **three** from:

- beef is best **or** beef is better than mycoprotein(*)
- mycoprotein mainly better than wheat(*)
- more phenylalanine in wheat than in mycoprotein(*)
allow equivalent numerical statements()*
- but no information given on other amino acids / costs / foods

3

overall conclusion:

statement is incorrect

or

it would be the best source for vegetarians

or

for given amino acids, beef is the best source

or

three foods provide insufficient data to draw a valid conclusion

1

[11]

3

(a) 94.8

1

(b) (i) to cool (the body) / maintain (body) temperature
*do **not** accept let out heat*

1

(ii) water **and** ions

1

(iii) water ignore CO₂, and vapour

1

- (c) any **two** from:
 used in respiration
 provides energy
 (energy) needed for movement / running / muscle action

2

[6]

4 in correct sequence:

breathing

1

diffusion

1

respiration

1

[3]

5 (a) respire

1

oxygen / glucose
 glucose / oxygen } each once only

2

blood

1

carbon dioxide / heat
 heat / carbon dioxide } each once only

2

[6]

6 (a) (before exercise) – 9 to 11 **and** (after exercise) – 12 or 13
both correct

1

(b) 0.75 to 0.90

ignore working or lack of working

eg. $2.35 - 1.55$ **or** $\frac{(2.35 - 1.0) \times 60}{100}$ **or other suitable figures**
 for **1** mark

2

(c) any **four** from:still need to remove extra carbon dioxide

still need to remove heat / to cool

(some) anaerobic respiration (in exercise)

lactic acid made (in exercise)

oxygen needed to break down lactic acid **or** suitable reference to oxygen debtlactic acid broken down to CO₂ and water **or** lactic acid changed into glucose

4

[7]**7**any **four** from:

more energy / respiration required

*accept it prevents / reduces anaerobic
 respiration **or** less / no lactic acid*

*reference to increase must be made,
 but only needed once, provided*

inference is clear for remainder of points.

accept 'delivered more quickly' for 'increase'

increase oxygen uptake into blood (in lungs)

increase oxygen delivery to muscles

increase glucose delivery to muscles

increase removal of heat from muscles **or** increase delivery of heat to skin

increase removal of carbon dioxide from muscles

increase removal of carbon dioxide from blood (in lungs)

[4]

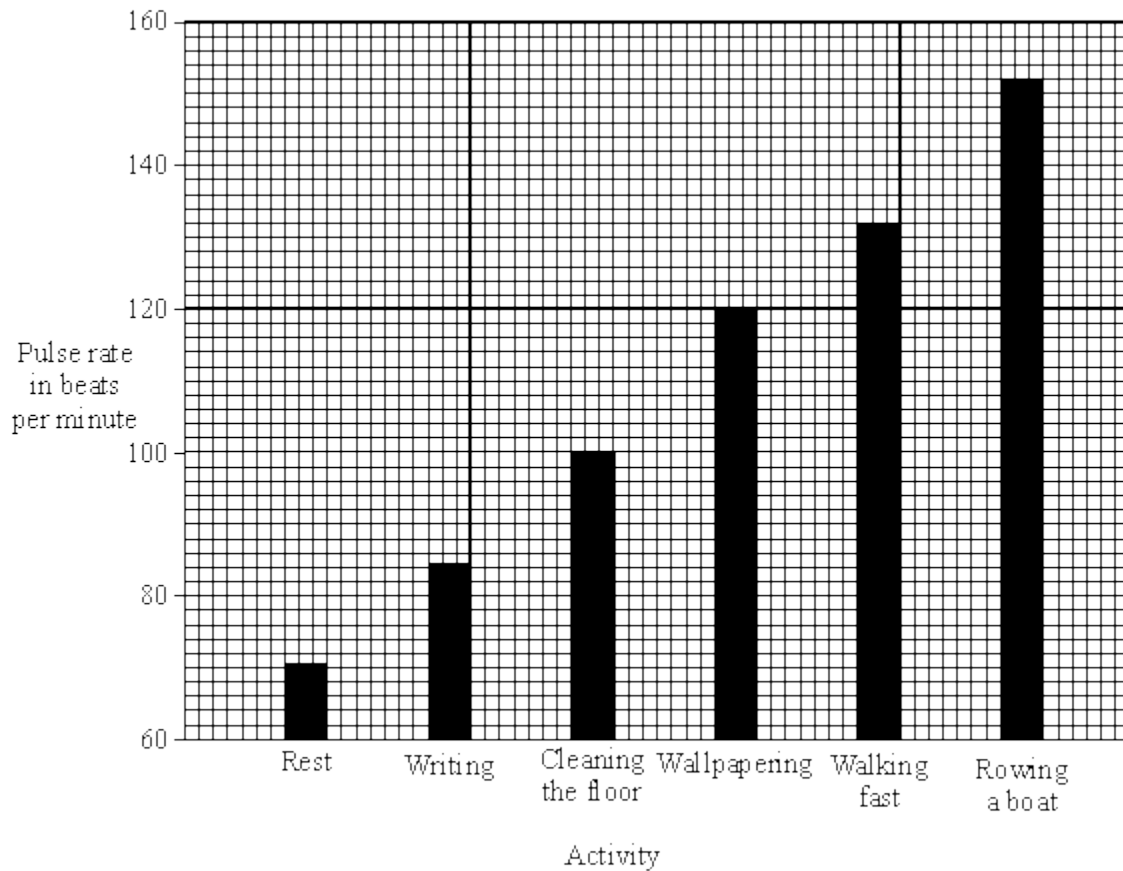
8

- (a) (i) count the pulse **or** count beats in artery in wrist neck **or** feel the pulse **or** take the pulse **or** find the pulse
*accept use of heart monitor **or** heart meter* 1
- (ii) 80
2 marks for correct answer
1f answer incorrect allow 1 mark for showing 8000 divided by 100
***or** indicating cardiac output divided by stroke volume* 2
- (iii) Increased activity stroke volume
falls / gets less / should get higher / reach a peak
*accept does not increase **or** changes from 134 cm³ to 127 cm³* 1
- (iv) 1 increased / more ventricle contractions
*accept heart beat faster **or** it beats faster **or** more powerful contractions* 1
- (b) (stronger heart muscle) increases cardiac output **or** increases stroke volume
*accept pumps more blood (per beat) **or** pumps blood faster*
ignore heart bigger 1
- so more (oxygenated) blood can be sent to muscles
accept more oxygen sent to muscles 1

[7]

9

- (a) (i) plotting values for pulse rates;
2 marks- minus 1 mark for each error to a maximum of 2
Accept values if plotted on blood volume bar chart
Non-horizontal tops to bars producing variable values = 1 error
If drawn as a line graph =1 mark maximum 2



(ii) **Either**

volume of blood went up then fell;

Accept went to a maximum then fell

pulse rate increased (steadily);

Accept went up steadily or kept going up

2

Or

at first **or** with low activity **or** with moderate activity both pulse and volume increased;

Accept activity up to wall- papering

with more activity pulse continued to increase but volume fell;

(b) Any **two** of

with increased activity greater muscle use **or** greater respiration;

need more glucose **or** oxygen;

Accept more sugar

heart beat faster;

Do not accept more air

*Accept more blood needed **or** blood flows faster*

*If 'more' **or** equivalent stated once it can be accepted elsewhere by implication*

2

[6]**10**

X – oxygen

accept O₂

Y – carbon dioxide

accept CO₂

[2]**11**

(i) with exercise rate rises;

accept between 1 – 2 minutes rate rises

1

(when exercise stops) rate falls slowly;

*accept gentle fall **or** steady fall*

for answers which just describe a rise then a fall allow one mark only as an alternative to the first two points

1

rate does not return to normal **or** to starting **or** to resting rate

*accept rate returns to normal after five minutes **or** three minutes of rest **or** after recording ended*

1

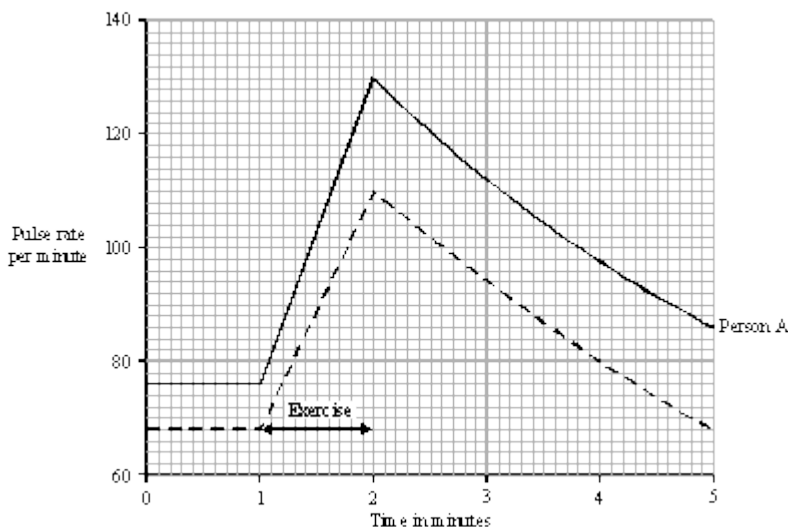
(ii) 86 (per minute);

1

(iii) plotting points;

deduct one mark for each error to max of two

if 68 wrongly plotted count as one error (ignore the quality of the line)



2

[6]

12

- (a) oxygen;)
 carbon dioxide;) *allow symbols*
 water)

each for 1 mark

3

- (b) graph with reasonable vertical scales;
 accurate plotting of all points (ignore lines) and labelling lines
 histogram – must be coded

gains 3 marks

3

- (c) 6 of:
 during exercise the level of CO₂ (in the blood) rises;
 increased breathing to remove excess CO₂;
 increased oxygen supply to muscles;
or increased breathing takes in more O₂
or increased heart rate takes more O₂ to muscles;
 increased supply of sugar to muscles;
 increased respiration rate;
 enable faster rate of energy release;
 reference to lactic acid (allow even though not on syllabus)/O₂ debt;
 to avoid cramp;
 anaerobic reference;
 reference to removal of 'heat';

6

- (d) high carbon dioxide concentration;
brain/central nervous system;
heart muscles (both)

3

[15]**13**

- (a) glucose/sugar water
for 1 mark each

2

- (b) (i) 204
for 1 mark

1

- (ii) 49 **gains 2 marks**
(incorrect answer, but correct method gains 1)

2

- (iii) 3 **gains 2 marks**
(incorrect answer, but correct method gains 1)

2

[7]**14**

- (a) (i) reduced sharply
for 1 mark

1

- (ii) converted to glucose which is respired to produce energy
(allow answers in terms of glucagon)
gains 3 marks

3

- (b) (i) athlete A's was most effective
since resulted in highest muscle glycogen level on day of race
for energy release during race
for 1 mark each

3

- (ii) e.g. excess carbohydrate stored as glycogen rather than fat in short term
particularly if glycogen stores depleted
for 1 mark each

2

[9]

15	(a) oxygen, carbon dioxide or water (vapour) <i>for 1 mark each</i>	2	
	(b) idea of more air per breath/deeper breaths <i>for 1 mark</i>	1	
	(c) (i) respiration <i>for 1 mark</i>	1	
	(ii) carbon dioxide, water <i>for 1 mark each</i>	2	
	(iii) more energy required, for increased muscular activity <i>for 1 mark each</i>	2	[8]
16	(a) more energy needed, for increased muscular activity <i>for 1 mark each</i>	2	
	(b) increased sweat production, evaporation of sweat cools body, vasodilation OWTTE, more heat loss (by radiation) <i>for 1 mark each</i>	4	[6]
17	(i) the higher the rate of oxygen consumption, the shorter the time taken to complete <i>for 1 mark</i>	1	

- (ii) the faster oxygen is taken into the blood,
the faster energy can be released in the muscles,
and the faster the athlete can run

for 1 mark each

3

[4]

18

- (i) increase in CO₂ concentration leads to increase in volume of air inhaled
increase of % carbon dioxide has little effect over most of range / large
increase when % carbon dioxide > 5.6 %

each for 1 mark

2

- (ii) *idea that*
depth of breathing changes at low % carbon dioxide, increase in % CO₂
results in volume of each breath increasing without increase / little increase
in number of breaths

each for 1 mark

2

[4]

19

- (a) trachea / windpipe
bronchus
alveoli
diaphragm

for 1 mark each

4

- (b) alveoli / air sacs (*reject capillaries*)

for one mark

1

- (c) respiration

for one mark

1

[6]

20	(i) $0.25 \times 100 / 25$ <i>gains 1 mark</i>	2	
	but 1% <i>gains 2 marks</i>	2	
	(ii) muscle contraction / limb movement / moving around / chewing heartbeat / breathing / internal muscle activity maintaining body temperature / keeps body warm active uptake synthesising substances (<i>reject growth</i>) <i>any three for 1 mark each</i>	3	[5]
21	(a) 11 <i>accept 10.5 – 11.5</i>	1	
	(b) ideas of increase / rises	1	
	frequently / often	1	
	energetically / violently	1	[4]
22	(a) falls	1	
	from 0.25	1	
	to 0.19 but by 0.06 gains two marks <i>if <u>neither</u> figure given, accept steadily / at constant rate for one mark accept mass of oxygen inversely related / negative correlation to height above sea level for 2 marks</i>	1	

(b) (i) 1.8

accept correct readings from graph for (5 and 6.8) if subtraction incorrect for one mark

allow one mark for correct subtraction from incorrect readings

2

(ii) (blood can carry) more oxygen

1

[6]**23**any **three** from:

heat produced by muscles

during exercise

accept when working

by respiration

(skin) temperature over muscles rises / more blood to skin over muscles

*allow vasodilation **or** arterioles dilate over muscles*

reject capillaries dilate

sweating neutral

[3]**24**

(a) respiration

reject start respiring / respire only at night

1

no photosynthesis because no light

1

(b) photosynthesis rate greater than respiration rate

1

reject no respiration / photosynthesis only

photosynthesis since light

1

[4]**25**

(a) 850

1

- (b) (i) more
 because exercise makes us sweat **or** work harder
accept to cool the body
do not credit body hotter or giving off more heat 2
- (ii) more
 because she respire more
*accept she breathes (in and out) more **or** heavier **or** faster* 2
- (iii) less
 because (more) water has been lost by sweating **or** breathing out **or** other methods
accept arguments about conservation of water 2
- (c) kidney 1

[8]**26**

- (a) (i) trachea
accept windpipe 1
- (ii) (left) lung **or** lungs
do not credit right lung 1
- (b) carbon dioxide **or** water vapour
do not credit just 'water' 1
- oxygen
answers in terms of used air or fresh air or of temperature differences are not acceptable 1

[4]

- 27** (i) (aerobic) respiration
do not credit anaerobic respiration
accept cellular respiration 1
- (ii) carbon dioxide and water (vapour)
both required
do not credit heat 1
- [2]**
-
- 28** (a) (i) oxygen
do not credit air 1
- (ii) lung(s)
do not credit blood or nose or windpipe alone but accept as a neutral answer if included with lungs 1
- (b) oxygen 1
- lactic acid
both words required 1
- [4]**
-
- 29** (i) 6 in both spaces
do not credit if any formula has been altered 1
- (ii) glucose
allow fructose or dextrose 1
- (iii) mitochondria
accept organelles 1
- [3]**

- 30** (i) any **two** from
- * (heart) more muscular
accept bigger
 - * (heart) more powerful
accept more efficient
accept stronger
- 2
- (ii) * pauses longer between (heart) beats
accepts beats more slowly
accept heart rate decreases
- * less fast around the heart
recovers more quickly not just 'heart healthier'
do not credit pulse rate slower
- 2
- [4]**
-
- 31** (a) more water vapour
accept more water
- 1
- more carbon dioxide
- 1
- less oxygen
- 1
- (b) (i) glucose
accept carbohydrate(s)
accept sugar(s)
- 1
- (ii) heat
or *thermal*
or *internal kinetic*
- 1
- (iii) lungs
accept alveoli / alveolus
do not credit air sacs
do not credit capillaries
both neutral if included with lungs
- 1

(c) oxygen

accept O₂

1

lactic

1

[8]**32**

(a) (i) photosynthesis

1

(ii) respiration

*do not credit combustion**do not credit decay*

1

(iii) dry

*accept hot **or** windy **or** drought*

1

(b) any **three** from

* evaporation (of water)

***or** loss of water vapour*

* (mostly) from the leaf / leaves

do not credit incorrect reference to leaves

* through the stomata

*accept through each stoma**accept through the stomas(sic)*

* causing a pull

or** causing an increase in osmotic potential (at the top of the plant)*or** causing an increase in water potential (at the top of the plant) **or****causing a decrease in osmotic pressure (at the top of the plant)*

* (so that) water moves up (through the plant)

do not credit water vapour moves up through the plant

* as the transpiration stream

* water enters through roots (and goes up plants)

3

[6]

- 33** (i) respiration 1
- (ii) oxygen **or** O₂
do not accept O or O² 1
- (iii) carbon dioxide **or** CO₂
do not accept CO² 1
- [3]**

- 34** (a) to transfer / provide / give release energy
or production of ATP / adenosine triphosphate (molecules)
accept to give heat 1
- (b) (i) C₆H₁₂O₆ + 6O₂ → 6CO₂ + 6H₂O
accept any other
n : 6n : 6n : 6n ratio
do not credit if any other changes have been made 1
- (ii) glucose
do not credit sugar / sucrose 1
- (c) (i) any **two** from
large surface
thin (surface)
moist (surface)
(with a good) blood supply 2
- (ii) carbon dioxide
accept water vapour
do not credit just water 1

(d) (i) anaerobic (respiration)

1

(ii) any **three** from

in mitochondria

glucose decomposes / breaks down / reacts

or glucose → *lactic acid for (2) marks*

to give lactic acid

or breathing hard

or lactic acid → *CO₂ + water*

causing pain

(leaving an) oxygen debt

(quick) source of energy

(but) less efficient than aerobic respiration

accept less efficient than with oxygen

3

[10]**35**

(i) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

energy is neutral

1

formulae all correct

with no omissions / deletions

correctly balanced

*credit 1 mark if the answer is the exact
reverse of an incorrect answer for (a)*

1

(ii) and **three** from

take up of (soluble) substances / ions against the concentration gradient

or when the concentration (of the substance / ions) is greater inside the cell / cytoplasm than outside it

through the (semi-permeable) (cell) membrane energy from mitochondria

*or energy from respiration
not just energy*

3

[5]**36**

(a) oxygen passes from the air/lungs into the body

gains 1 mark

but

oxygen passes from the air/lungs into the blood

gains 2 marks

carbon dioxide passes from the body into the air/lungs

gains 1 mark

but

carbon dioxide passes from the blood into the air/lungs

gains 2 marks

4

(b) increased/5% more

gains 1 mark

but

6 times more (in air breathed out)

gains 2 marks

2

[6]

37

- (a) *idea*
- O₂ increases
- CO₂ decreases

for 1 mark each

2

- (b) (i)
- | | | |
|------------------|------------------|--------------------|
| <u>reduced</u> | <u>unchanged</u> | <u>increased</u> |
| digestive system | brain | skin |
| bone | | muscles |
| | | heart and arteries |

- All (6) correct gains 4*
- 5 correct gains 3*
- 4 correct gains 2*
- 2/3 correct gains 1*

Correct wording not needed if unambiguous. No mark if organ repeated.

4

- (ii) more/higher/quicker/faster
- gains 1 mark*

but
7500 more/from 5,000 to 12,500 more
gains 2 marks

but
7500 cm³/min more
gains 3 marks

or 2½ times more

3

[9]

38

- (a) carbon dioxide in range 2.5-5%
gains 1 mark

but

carbon dioxide closer to 4% than to 3% or 5%
gains 2 marks

OR

oxygen in range 15-17.5%
gains 1 mark

but

If 3 sectors drawn and two correctly labelled,
award marks and ignore remaining sector
Oxygen and carbon dioxide sectors labelled
for 1 mark

3

- (b) carbon dioxide
oxygen
for 1 mark each

Do not allow water vapour.
(Allow correct symbols/formulae)

2

[5]

39

- (a) less / low
gains 1 mark

but

(also) half as much **or** still one fifth of what's breathed in
gains 2 marks

2

- (b) for energy / respiration [credit for movement / to keep warm]
[Do not allow "to live"]
for 1 mark

1

[3]

40

- (a) (i) points correctly plotted
all correct gains 2 marks
2 correct gains 1 mark
- each part of line correctly drawn (i.e. curve + straight line)
for 1 mark each part of line
- 4
- (ii) 3 (or according to plotted graph)
 litres per second
for 1 mark each
- 2
- (b) lungs
 blood
- for 1 mark each*
- 2
- (c) (i) *ideas that*
- energy transferred faster in 100m race
 - carbon dioxide produced faster during 1500m race / more
 - carbon dioxide produced
- for 1 mark each*
- 3
- correct reference to twice / half as fast in either / both cases
for a further mark
- 1
- (ii)
- respiration during 100m race (mainly) anaerobic
 - respiration during 1500m race (mainly) aerobic
 - aerobic respiration produced carbon dioxide
 - anaerobic respiration produced / lactic acid
- for 1 mark each*
- 1

[13]

41

(a)

- appropriate scales (> halfway along each axis)
- all points correctly plotted to better than $\frac{1}{2}$ a square
- lines carefully drawn

(allow point to point in this case)

N.B.

- no mark available for labelling axes
- *allow* either orientation
for 1 mark each

3

(b) (i) *ideas that*

- energy transferred faster in 100m race
(not more energy transferred)
- carbon dioxide produced faster during 1500m race
for 1 mark each

(allow more carbon dioxide produced)

correct reference to twice / half as fast in either / both cases
for 1 further mark

3

(ii)

- respiration during 100m race (mainly) anaerobic
- respiration during 1500m race aerobic
- aerobic respiration produces carbon dioxide
- anaerobic respiration doesn't produce carbon dioxide
/ produces lactic acid
any two for 1 mark each

2

(c) *ideas that*

- there is an oxygen debt / more than normal oxygen needed
- lactic acid needs to be oxidised / combined with oxygen
for 1 mark each

2

[10]