Q1.

(a) phloem

1

(b) translocation

1

(c) either:

less (sugars for) respiration

1

(so) less energy released

1

or

less amino acids made (1)

(so) less protein produced **or** less protein synthesis (1)

or

less cellulose made (1)

(so) weaker cell walls (1)

(d) (aphids) can fly to another plant **or** part of the plant

ignore to fly unqualified

1

to get (more) food

allow to find a mate
allow idea of less competition for food
allow to escape predators
*do **not** accept escape prey*

1

(e) (oil) prevents aphids from attaching to leaf **or** causes aphids to slide off leaf

ignore 'the leaf is slippery'

or
idea that oil may harm / kill the aphid

allow oil may be unpleasant to the aphid

1

(f) (plant / stem has) thorns

allow spines / spikes / prickles
ignore stings
*do **not** accept thorns protect (the plant) from predators*

1

(g) C

if any other letter given then no marks for the question

1

(fungi / spores) blown by / in direction of the wind

allow black spot / disease is blown by / in direction of the wind

or

it's the closest plant (to A)

*do **not** accept reference to bacteria / viruses / pollen being blown*

1

(h) any **one** from:

- spread rose bushes out more

  allow isolate the infected plant
  allow idea of barrier around infected plant
  ignore separate unless qualified

- remove any infected parts of the plant

  allow remove infected plant / A

- use a fungicide

  ignore pesticide
  *do **not** accept insecticides / herbicide*

1

[11]

Q2.

(a) diffusion

1

(b) A

1

(c) B

1

(d) (earthworm) can absorb more oxygen (in a given time)
or
increases / more gas exchange

allow get / obtain / take in more oxygen
ignore easier absorption of oxygen
ignore references to food

1

(e) lipase

1

(f) more oxygen (in soil with earthworms)

allow earthworms bring oxygen to soil

1

(for) more (aerobic) respiration

*do **not** accept anaerobic respiration*

1

(of) bacteria / fungi / microorganisms / microbes / decomposers

1

reference to more is only needed once for the first two marking points

(g) fertilisation

ignore sexual reproduction

1

(h) asexual (reproduction)

allow cloning

1

[10]

Q3.

(a) any **one** from:

- respiration
- formation of proteins
- formation / breakdown of glycogen
- breakdown of (excess) protein **or** formation of urea
- photosynthesis **or** formation of glucose / starch (in plants)

ignore formation of carbohydrates

1

allow other correct reference to metabolic reactions in cells
ignore reference to digestion

(b) males have a higher metabolic rate than females after five years of age

1

the mean metabolic rate of females decreases faster than males up to 25 years of age

1

each additional tick negates a mark

(c) $\frac{17}{53} \times 100$

1

32.075472…

allow correct rounding of this to at least 4 significant figures

1

32.1

allow a correct reduction to 3 significant figures from an incorrect calculation for marking point 2

1

*an answer of 32.1 scores **3** marks*

(d) any **two** from:

allow converse

- (person) R heart rate rose / increased more slowly than (person) S
- (person) R heart rate levelled off whereas (person) S continued to increase
- (person) R heart rate rose less (overall / after 5 minutes of exercise) than S

allow correct use of figures
e.g. R increased (overall) by 39 bpm / 65% and S by 54 bpm / 69%
ignore lack of units

2

(e) correct scale and axis labelled

allow min(s)
*do **not** accept 'm'*
the zero is not required on the x-axis

1

all points plotted correctly (to within ± ½ square)

*allow 4 or 5 correct plots for **1** mark*

2

line joined point to point or correct curved line of best fit

1

(f) $\frac{132-78}{12}$

allow $\frac{54}{12}$

allow sequential deductions of 12 four or five times

1

4.5 (minutes) / 4½ minutes / 4 minutes 30 seconds / 4:30

*do **not** accept 4:50 **or** 4 minutes 50 seconds*

1

*an answer of 4.5 minutes scores **2** marks*

(g) **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- two groups of people − non-smokers and smokers
- have at least five people in each group or large groups
- get each person to do (named) exercise
- controlled variables:
  - same number of people in each group or large groups
  - same gender
  - same level of activity / exercise
  - same age
  - no health issues / illnesses
  - same type of exercise
  - same time for exercise
- record heart rate for each person before and after exercise
- calculate increase in heart rate for each person after exercise
- compare results for each group

for **level 3**, students should refer to at least 5 smokers and 5 non-smokers, carrying out exercise with control variables and a means of determining an increase in heart rate

for **level 2**, students should refer to 'groups' of smokers and non-smokers exercising

[20]

Q4.

(a) kills microorganisms / bacteria / fungi / viruses / microbes

allow to remove microorganisms / bacteria / fungi / viruses / microbes

ignore germs

allow so mycoprotein is not contaminated

1

(which) compete for food / oxygen
or
which make toxins

allow so mycoprotein is safe to eat

or
which are pathogens
or
which might kill the fungus / *Fusarium*

1

(b) 30 °C

1

(c) for (aerobic) respiration

*do **not** accept anaerobic*

1

(which) releases energy (for growth)

*do **not** accept produces energy*

allow glucose is used to make other organic substances e.g. protein

1

(d) any **two** from:

so *Fusarium* can
- grow faster / better
- get sufficient food / glucose / minerals
  allow more / enough
- get sufficient oxygen
  allow more / enough
- get rid of sufficient carbon dioxide
  allow more / enough
  allow waste
- be kept at a (suitable) temperature
  allow to avoid 'clumping'

2

(e) 200 grams

1

[8]

Q5.

(a) 2400 **and** 2280
or
500 **and** 380

1

120

1

*an answer of 120 scores **2** marks*

(b) respiration of glucose

1

(c) (more) sweating

ignore reference to vasodilation / vasoconstriction

1

(because) exercise releases heat
or
need to cool the body
or
need to lose heat
or
need to maintain body temperature

*do **not** accept energy being produced*

1

(d) more energy needed

*do **not** accept energy production*
*do **not** accept energy needed for respiration*

1

(so) more (aerobic) respiration

1

(so) increased breathing (rate / depth) (to supply oxygen **or** remove carbon dioxide / water)

1

'more' does not need to be stated a second time to gain marking point 1 and marking point 2

[8]

Q6.

(a) *x*-axis: scale + labelled, including units

scale ≥ ½ width of graph paper label: biomass in g/m²

1

bar widths correct

± ½-square each side
allow 1 mark if 3 correct

2

all 4 bars correctly labelled

large fish + small fish + invertebrate (animals) + algae
or
(trophic level) 4 + 3 + 2 + 1
or
tertiary consumer + secondary consumer + primary consumer + producer
ignore bar heights

1

(b) $\frac{840-10}{840} \times 100$

allow equivalent calculation

1

98.809523... / 98.810 / 98.81 / 98.8

1

99

allow answer given to two significant figures from an incorrect calculation in step 2

1

*an answer of 99 scores **3** marks*

(c) inedible parts / example

*allow eaten by other animals **or** not all organisms eaten*

or

egested / faeces

allow not digested
allow excretion / urine
ignore waste

or

respiration / as CO_2

ignore energy losses
ignore movement

1

(d) bacteria decay organic matter / sewage / algae / dead plants

1

(by) digestion

allow example such as starch broken down to sugar
or
protein broken down to amino acids

1

(and) bacteria respire aerobically
or
respire using oxygen

1

(which) lowers oxygen concentration (in water)
or
fish have less oxygen

allow reduced respiration of fish

1

(so) reduced energy supply causes death of fish

allow toxins in the sewage kill fish
ignore pathogens or (pathogenic) bacteria cause disease in fish and kills them

1

[13]

Q7.

(a) $C_6H_{12}O_6$

1

(b) atmospheric air contains less carbon dioxide than exhaled air

allow converse

1

(flask B goes more cloudy because) carbon dioxide is produced in (aerobic) respiration (by woodlice)

*do **not** accept anaerobic respiration*

1

(c) for comparison / to compare

allow answers in the context of the investigation e.g.

or

to check that no other factor / variable is influencing the results

to prove that the results obtained were due to the woodlice respiring and nothing else

or

to prove that the woodlice produced the carbon dioxide and nothing else

1

(d) (flask **A**) would remain colourless

ignore references to clear

allow not cloudy

1

(flask **B**) would remain colourless

1

(e) lactic acid

1

(f) alcohol / ethanol

1

[8]

Q8.

(a) electron (microscope)

1

(b) $\frac{30000}{200}$

*an answer of 150 (μm) scores **2** marks*

1

150 (μm)

*if answer is incorrect allow for **1** mark sight of 0.015 / 0.15 / 1.5 / 15*

*allow ecf for incorrect measurement of line **X** for max **1** mark*

1

(c) **either**

large surface area

allow (vacuole contains) cell sap that is more concentrated than soil water (1)

1

for more / faster osmosis

create / maintain concentration / water potential gradient (1)

or

allow thin (cell) walls

for short(er) diffusion distance

1

(d) (on hot day) more water lost

allow converse for a cold day if clearly indicated

1

more transpiration
or
more evaporation

1

so more water taken up (by roots) to replace (water) loss (from leaves)

1

(e) (aerobic) respiration occurs in mitochondria

*do **not** accept anaerobic respiration*

1

(mitochondria / respiration) release energy

*do **not** accept energy produced / made / created*

1

(energy used for) active transport

1

to transport ions, against the concentration gradient
or
from a low concentration to a high concentration

1

[12]

Q9.

(a) an undifferentiated / unspecialised cell

1

that can differentiate / become / change into (many) other cell types

1

(b) (malignant tumours) invade / spread to other tissues via the blood (benign don't)
or
(malignant tumours) form secondary tumours in other organs

ignore cancer unqualified
allow converse
allow metastasises

1

(c) mitosis

correct spelling only

1

(d) glucose

answers in any order
ignore sugar

1

protein / amino acids

1

(e) no need to wait for a donor
or
can be done immediately

1

(so) no risk of rejection
or
no need for immunosuppressant drugs

*if no other marks awarded, allow for **1** mark idea of ethics surrounding the use of tissue from another / dead person*

1

(f) stent opens up the trachea

1

allowing air to flow through
or
allowing patient to breathe

1

(g) **Level 3 (5-6 marks):**
A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

Level 2 (3-4 marks):
Some logically linked reasons are given. There may also be a simple judgement.

Level 1 (1-2 marks):
Relevant points are made. They are not logically linked.

Level 0
No relevant content

Indicative content

embryos advantages
- can create many embryos in a lab
- painless technique
- can treat many diseases / stem cells are pluripotent / can become any type of cell (whereas bone marrow can treat a limited number)

embryos disadvantages
- *harm / death to embryo*
- *embryo rights / embryo cannot consent*
- *unreliable technique / may not work*

bone marrow advantages
- no ethical issues / patient can give permission
- can treat **some** diseases
- procedure is (relatively) safe / doesn't kill donor
- tried and tested / reliable technique
- patients recover quickly from procedure

bone marrow disadvantages
- *risk of infection from procedure*

- *can only treat a few diseases*
- *procedure can be painful*

both procedures advantage

can treat the disease / problem

both procedures disadvantages

- *risk of transfer of viral infection*
- *some stem cells can grow out of control / become cancerous*

[16]

Q10.

(a) salivary glands and pancreas

1

(b) starch / substrate fits into active site (of enzyme)

1

shape of active site is unique / complementary to substrate

allow converse

or

substrate is specific to active site / enzyme

allow enzyme has a high specificity for substrate

1

bonds (within starch / substrate

or

between sugar molecules) are broken

1

(c) converted to new carbohydrates / glycogen / named organic compound (e.g. protein / fat)

1

(d) to allow (the starch and amylase / solutions) to equilibrate (to the temperature of the water bath)

or

to get the starch and amylase / solutions to the same temperature / 20 °C

or

to get the starch and amylase / solutions to the (same) temperature of the water bath

1

(e) **40 °C**

all wells contain a symbol

and

must contain at least two crossed (×) wells at the end

allow final three wells crossed (×)

1

60 °C

all wells contain a symbol

and

must have fewer than at 40 °C crossed (✖) wells at the end

allow all wells ticked (✓)

*for either mp do **not** allow a crossed well followed by a ticked well*

1

(f) more accurate

allow (so) closer to (the) true value

1

(because) it is a quantitative measure

allow (it's) an actual value as opposed to an opinion

or

less / not subjective

allow colour is only qualitative

1

(g) 0.07 (%)

1

(h) starch is broken down less quickly (at 20 °C)

allow converse

1

because, at 20 °C, substrates / enzymes / molecules have less (kinetic) energy

1

(i) 1.08 (arbitrary units)

1

at 80 °C, enzyme / amylase has denatured

allow description of denaturation

*do **not** allow enzyme is killed*

1

so starch is not broken down (at all)

allow the concentration of starch is still 0.5%

1

[16]

Q11.

(a) correct figures from graph: 5.0 / 5 and 2.60 / 2.6

2.40 / 2.4

*an answer of 2.40 / 2.4 scores **2** marks*

1

*allow correct answer from candidate's figures from graph for **1** mark*

1

(b) $\frac{1}{3}$

1

(c) protein

1

(d) a genetically-modified variety of seed was sown in 2004

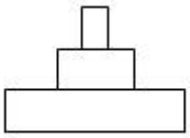
1

more rain fell in spring and early summer in 2004

1

the mean summer temperature was lower in 2003

1

(e) 

1

(f) 80

1

(g) chickens use energy for movement and for keeping warm

1

much of the food eaten by chickens is wasted as faeces

1

[11]

Q12.

(a) any **two** from:
- sprinkled through air
- air spaces between stones
- thin layer over stones (for efficient diffusion)
- slow flow (for efficient diffusion)

2

(b) green algae

1

(c) (large / small) protist

1

(d) **Level 2 (3-4 marks):**
Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

Level 1 (1-2 marks):
Facts, events or processes are identified and simply stated but their relevance is not clear.

No relevant content (0 marks)

Indicative content

digestion:
- (external) enzymes released

- role of enzymes – e.g. amylase / protease / lipase
- substrates & products – e.g. starch ⟶ sugar / protein ⟶ amino acids / fat ⟶ fatty acids

absorption:
- by diffusion / active transport

deamination:
- amino acids ⟶ ammonia / ammonium ions

release of other ions:
- e.g. phosphate / nitrate / magnesium

respiration:
- produces carbon dioxide (+ water)
  or
  equation is given
- release of energy allows other processes to take place e.g. active transport

[8]

Q13.

(a) no oxygen (is used)

1

(b) muscles become fatigued / stop contracting

1

because not enough energy is transferred

1

(c) carbon dioxide

1

(d) count the bubbles
or
measure volume of gas

1

in a given time

1

(e) brewing / bread making

allow other suitable use of fermentation in food industry

1

[7]

Q14.

(a) glucose is absorbed by diffusion into the bloodstream

1

then blood delivers glucose to muscles in capillaries

1

(b) to stop air getting in

1

(c) yellow

1

(d) collect the CO_2 / gas with a measuring cylinder / gas syringe

1

(volume collected) in a certain time using a timer / watch

1

(e) yeast produces ethanol but muscles produce lactic acid

marks can be awarded from correct word or balanced symbol equations

1

yeast produces CO_2 but muscles do not

answers must be comparative

1

both release small amounts of energy

1

ignore both occur without oxygen

[9]

Q15.

(a) methane is produced

ignore bad smell

1

which is a greenhouse gas / causes global warming

1

(b) (9.80 / 0.20 = 49 therefore) 49:1

1

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

Level 2 (3–4 marks):
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

Level 1 (1–2 marks):
Simple statements are made, but no attempt to link to explanations.

0 marks:
No relevant content.

Indicative content

statements:
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

explanations:
- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

use of carbon in growth:
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

6

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

allow reference to bacteria / fungi / mould

3

[13]

Q16.

(a) any **one** from:
- continuous readings
- do not need to be there

allow automatic readings
- (more likely to be) accurate

allow greater resolution

*do **not** allow valid*
- reduces human error

allow easier to read

1

(b) (i) microorganisms

allow microbes / bacteria / fungi / decomposers for microorganisms, throughout

1

(microorganisms) respire

1

respiration / decay / microorganisms releases carbon dioxide

ignore carbon released

1

(ii) all grass decomposed / decayed / rotted

*allow idea that all microorganisms dead (due to accumulation of waste **or** lack of oxygen)*

allow lack of / no oxygen (for respiration of microorganisms)

1

[5]

Q17.

(a) (i) without <u>oxygen</u>

allow not enough oxygen

ignore air

ignore production of CO_2

ignore energy

1

(ii) more / high / increased lactic acid (at end)

allow approximate figures (to show increase)

ignore reference to glucose

1

(b) (i) 1.5

allow only 1.5 / 1½ / one and a half

1

(ii) increases at first **and** levels off

ignore subsequent decrease

1

suitable use of numbers eg
rises to 10 / by 9 (dm^3 per min)
or
increases up to 1.5 (min) / levels off after 1.5 (min) (of x axis timescale)

allow answer in range 1.4 to 1.5

or
after the first minute (of the run)

1

(iii) supplies (more) oxygen

1

supplies (more) glucose

1

need 'more/faster' once only for full marks

*allow removes (more) CO_2 / lactic acid / heat as an alternative for either marking point one **or** two, **once** only*

for (more) respiration

1

releases (more) energy (for muscle contraction)

*do **not** allow energy production or for respiration*

1

[9]

Q18.

(a) The damaged alveolus has a smaller surface area.

1

(b) Less oxygen is taken in.

1

[2]

Q19.

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

- glucose
- oxygen
- carbon dioxide
- urea
- water

allow hormones

allow named example of a product of digestion

1

(ii) (cardiac) muscle

allow muscular

1

(b) (i) **B**

1

(ii) **D** atrium / atria

ignore references to left or right

1

E ventricle(s)

ignore references to left or right

1

(c) (i) a vein

1

(ii) an artery

1

(iii) keeps artery open / wider

allow ecf from part cii

1

(so) blood / oxygen can pass through (to the heart muscle)

1

[9]

Q20.

(a) $6H_2O$

in the correct order

1

$C_6H_{12}O_6$

1

(b) (i) control

do not accept *'control variable'*

allow:

to show the effect of the organisms

or

to allow comparison

or

to show the indicator doesn't change on its own

1

(ii) snail respires

1

releases CO_2

1

(iii) turns yellow

1

plant can't photosynthesise so CO_2 not used up

1

but the snail (and plant) still respires so CO_2 produced

1

[8]

Q21.

(a) (i) 50

1

(ii) 4

accept 3.9 − 4.0

1

(b) (i) glucose

1

oxygen

1

(ii) to release more energy

1

(c) correct readings from graph:

a = 120

b = 60

allow 60 - 61

1

calculation correct for candidate's figures:

e.g. a − b = 60

1

level of fitness correct for candidate's figures:

e.g. very fit

1

(d) any **four** from:
- higher heart rate (at 16 km / h) (so takes longer to slow to normal)
- more energy needed
- not enough O_2 supplied / more O_2 needed / reference to O_2-debt
- (more) anaerobic respiration
- (more) lactic acid made / to be broken down / to remove / to oxidise
- higher blood flow needed to deliver (the required amount of) oxygen.

'more' must be given at least once for full marks

do not allow more energy produced

allow higher blood flow to remove lactic acid / remove (additional) CO_2

4

[12]

Q22.

(a)

Structure	Organ	Organ system	Tissue
Stomach	✓		
Cells lining the stomach			✓
Mouth, oesophagus, stomach, liver, pancreas, small and large intestine		✓	

all 3 correct = 2 marks
2 correct = 1 mark
1 or 0 correct = 0 marks

2

(b) (i) diffusion

allow phonetic spelling

1

(ii) glucose

1

(iii) mitochondria

1

[5]

Q23.

(a) 5624

***allow 2 marks** for:*

- *correct HR = 148 **and** correct SV = 38 plus wrong answer / no answer*

or

- *only one value correct **and** ecf for answer*

***allow 1 mark** for:*

- *incorrect values **and** ecf for answer*

or

- *only one value correct*

3

(b) (i) **Person 2** has low(er) stroke volume / SV / described

*eg **Person 2** pumps out smaller volume each beat*

*do **not** allow **Person 2** has lower heart rate*

1

(ii) **Person 1** sends <u>more blood</u> (to muscles / body / lungs)

1

(which) supplies (more) oxygen

1

(and) supplies (more) glucose

1

(faster rate of) respiration **or** transfers (more) energy for use

ignore aerobic / anaerobic

allow (more) energy release

allow aerobic respiration transfers / releases more energy (than anaerobic)

*do **not** allow makes (more) energy*

1

removes (more) CO_2 / lactic acid / heat

allow less oxygen debt

or less lactic acid made
or (more) muscle contraction / less muscle fatigue

if no other mark awarded,

allow person 1 is fitter (than person 2) for max 1 mark

1

[9]

Q24.

(a) (i) has the least amount of glucose

*allow least amount of fat **or** no fat*

1

(to) transfer energy (for the run)

allow (to) release energy (for the run)

*do **not** allow produces energy*

*do **not** allow 'energy for respiration'*

1

(ii) any **one** from:
- cells will work inefficiently
- absorb too much water / swell / overhydrate
- lose too much water / shrink / dehydrate

ignore turgid / flaccid

cells burst is insufficient

allow cramp <u>in muscle</u>.

1

(b) any **three** from:
- thermoregulatory centre
- (has temperature) receptors
- (which) monitor blood temperature (as it flows through the brain)
- (temperature) receptors in the skin
- (receptors) send impulses to the brain

ignore vasoconstriction / vasodilation / sweating

allow hypothalamus

impulses sent to the thermoregulatory centre = 2 marks.

3

(c) (i) (sports drinks) contain a lot of glucose

1

(a person with diabetes) does not produce insulin **or** does not produce enough insulin

allow (person with diabetes) has cells which do not respond to insulin

*do **not** allow insulin produced by liver*

1

so <u>blood</u> glucose / sugar levels will rise too high **or** to a dangerous level

1

(ii) inject insulin
or
have an insulin pump (fitted)

*do **not** allow swallow insulin*

accept exercise

accept inhale insulin

*accept take metformin **or** other correctly named drug*

allow pancreatic transplant

1

[10]

Q25.

(a) (i) correct bar heights

*three correct **2** marks*

*two correct **1** mark*

*one or none correct **0** marks*

ignore width

2

(ii) (Stream Y)

has many sludge worms / bloodworms

or

has no mayflies / caddis or few shrimp

*allow **1** mark if invertebrate not named but correct association given*

1

which indicate medium or high pollution

1

(b) (i) suspended solids increase (as a result of sewage overflow)

1

then decrease downstream / return to original levels

1

oxygen levels decrease (after sewage overflow)

1

and then rise again

1

(ii) any **three** from:

- mayflies decrease (to zero) near overflow

  accept 'have died out'
- because oxygen is low **or** mayflies have high oxygen demand
- mayflies repopulate / increase as oxygen increases again
- can't be sure if dissolved oxygen or suspended solids is the cause

3

(c) they respire / respiration

*aerobic respiration gains **2** marks*

1

this requires / uses up the oxygen

1

[13]

Q26.

(a) anaerobic respiration

allow phonetic spelling

1

(b) (i) 4.4

4.2, 4.3, 4.5 or 4.6 with figures in tolerance (6.7 to 6.9 and 2.3 to 2.5) and correct working gains 2 marks

4.2, 4.3, 4.5 or 4.6 with no working shown or correct working with one reading out of tolerance gains 1 mark

*correct readings from graph in the ranges of 6.7 to 6.9 **and** 2.3 to 2.5 but no answer / wrong answer gains 1 mark*

2

(ii) more energy is needed / used / released

*do **not** allow energy production*

(at 14 km per hour)

ignore work

1

not enough oxygen (can be taken in / can be supplied to muscles)

allow reference to oxygen debt

*do **not** allow less / no oxygen*

1

so more anaerobic respiration (to supply the extra energy) **or** more glucose changed to lactic acid

allow not enough aerobic respiration

1

[6]

Q27.

(a) any **two** from:

***or** allow converse for outdoors*

- constant speed
  - *variable speed*
- constant effort
  - *variable terrain*
- constant temperature
  - *traffic conditions*
  - *variable temperature*
  - *wind (resistance)*
  - *rain / snow*

allow weather

allow pollution only if qualified by effect on body function but ignore pollution unqualified

if no other marks obtained allow variable conditions outdoors

2

(b) Brain

1

(c) (i) 20 800

*correct answer with or without working gains **2** marks*

*if answer incorrect, allow **1** mark for use of 1200 and 22 000 only*

2

(ii) oxygen

apply list principle

1

*do **not** accept other named substances eg CO_2 water*

glucose / sugar

allow glycogen

ignore food / carbohydrate

1

(iii) respire aerobically

1

(iv) carbon dioxide

1

lactic acid

1

(d) increased heart rate

ignore adrenaline / drugs

accept heart beats more but not heart pumps more

1

[11]

Q28.

(a) (i) **C** and **D**

no mark if more than one box is ticked

1

(ii) any **one** from:

*do **not** allow if other cell parts are given in a list*

- (have) cell wall(s)
- (have) vacuole(s)

1

(b) (i) **A**

apply list principle

1

(ii) **D**

apply list principle

1

(c) respiration

apply list principle

1

[5]

Q29.

(a) a higher concentration would be difficult to stir

1

(b) (i) methane

1

(ii) 60

100 - (5 + 35) but incorrect answer allow 1 mark

2

(c) (i) aerobic respiration

1

(ii) oxygen

1

[6]

Q30.

(a) 40 – 60 hours

1

(b) (i) decrease

1

1st slowly then faster / appropriate detail from the graph – e.g. from 7.8 to 0 / faster after 4 – 10h

1

(ii) oxygen after glucose

extra box ticked cancels 1 mark

1

oxygen less than glucose

1

(iii) respiration

1

[6]

Q31.

(a) A

no mark - can be specified in reason part
if B given - no marks throughout
if unspecified + 2 good reasons = 1 mark

high(er) pressure in A

allow opposite for B
*do **not** accept 'zero pressure' for B*

pulse / described in A

accept fluctuates / 'changes'
allow reference to beats / beating
ignore reference to artery pumping

2

(b) (i) 17

1

(ii) 68

accept correct answer from student's (b)(i) × 4

1

(c) oxygen / oxygenated blood

allow adrenaline

ignore air

glucose / sugar

extra wrong answer cancels - eg sucrose / starch / glycogen / glucagon / water

allow fructose

ignore energy

ignore food

2

[6]

Q32.

(a) circulating / mixing / described **or** temperature maintenance

1

supply oxygen
or for aerobic conditions
or for faster respiration

*do **not** allow oxygen for anaerobic respiration*

1

(b) energy supply / fuel / use in respiration

*do **not** allow just food / growth*

ignore reference to aerobic / anaerobic

or material for growth / to make mycoprotein

1

(c) respiration

allow exothermic reaction

allow 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 / to *Fusarium*

*do **not** allow harmful unqualified*

1

(ii) steam / heat treat / sterilise fermenter (before use)

not *just clean*

or
steam / heat treat / sterilise
glucose / minerals / nutrients / water (before use)
or
filter / sterilise air intake
or
check there are no leaks

allow sterilisation unqualified ***not*** *just use pure glucose*

1

(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 because
either
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

[10]

Q33.

(a) (i) **A** lung

1

B rib

1

C diaphragm

1

D alveolus / alveoli

1

(ii) (**B** moves) up(wards) / out / up and out

1

(**C** moves) down(wards) / flattens

*do **not** allow inwards*
ignore outwards
*if neither mark gained allow **1** mark for correct reference to muscle contraction*

1

(b) (i) 1640

1

1440

1

1720

*allow max **1** for 3 correct values using of bottom of piston:*
1380 + 1180 + 1480 to 1485

1

(ii) 1600

*correct answer gains **2** marks*
*if answer incorrect allow **1** mark for evidence of (1640 + 1440 + 1720) ÷ 3*
*allow ecf from **(b)(i)***
allow use of two numbers divided by two if one is considered anomalous:
$\frac{(1640 + 1720)}{2}$ *= 1680*
*for **2** marks*

2

(c) two groups of students − one group sports activity participants, other not

allow students as a group

1

fair test eg groups same height / same mass / same sex

1

measure air breathed in by each student / repeat previous experiment then calculate mean for group

1

(d) pointer remains still after breathing / cylinder will move down after breathing (in)

1

error reading volume less likely

allow more accurate / reliable

1

(e) (i) operator squeezes bag

1

air forced / pushed into lungs

or

positive pressure ventilator

1

(ii) any **two** from:

- air pressure / volume not regulated
- operator will tire / must be present <u>at all times</u> / variable intervals
- too much / too little air

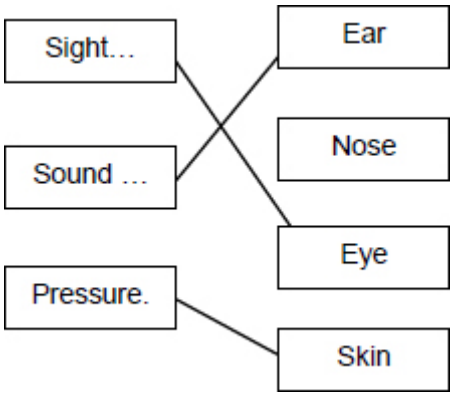
allow may 'overbreathe' the patient

2

[20]

Q34.

(a) (i)



1 *mark for each line*

do ***not*** *award a mark for a 'change' that has two lines*

3

(ii) receptor cells

1

(b) used to provide (extra) energy

allow (more) used in respiration

allow suitable reference to muscles

do ***not*** *accept used for sweat*

1

(c) (i) growth of muscles

1

(ii) (these drugs have) possible side / harmful effects
or
answers that refer to 'fairness of competition' e.g. cheating

1

[7]

Q35.

(a) (i) <u>rate of</u> chemical reaction<u>s</u> (in the body)

1

(ii) any **two** from:

- heredity / inheritance / genetics

- proportion of muscle to fat **or** (body) mass
  allow (body) weight / BMI
- age / growth rate
- gender
  accept hormone balance or <u>environmental</u> temperature
  ignore exercise / activity

2

(b) (i) 77

*correct answer with or without working gains **2** marks*
*allow **1** mark for 70 / 56 **or** 1.25 **or** 5*

2

(ii) increase exercise

accept a way of increasing exercise

1

reduce food intake

accept examples such as eat less fat / sugar
*allow go on a diet **or** take in fewer calories*
ignore lose weight
ignore medical treatments such as gastric band / liposuction

1

[7]

Q1.

(a) (i) <u>rate of</u> chemical reaction<u>s</u> (in the body)

1

(ii) any **two** from:

- heredity / inheritance / genetics
- proportion of muscle to fat **or** (body) mass
  allow (body) weight / BMI

- age / growth rate
- gender

accept hormone balance or environmental temperature
ignore exercise / activity

2

(b) (i) 77

*correct answer with or without working gains **2** marks*
*allow **1** mark for 70 / 56 **or** 1.25 **or** 5*

2

(ii) increase exercise

accept a way of increasing exercise

1

reduce food intake

accept examples such as eat less fat / sugar
*allow go on a diet **or** take in fewer calories*
ignore lose weight
ignore medical treatments such as gastric band / liposuction

1

[7]

Q2.

(a) LHS – glucose

1

RHS – water

allow H_2O / H2O

1

(b) so the earthworms' body temperature would change to 20°C

1

(c) (i) 56 or 55 or 54

*if incorrect answer given accept 60 - 5 for **1** mark*
*or 60 – 6 for **1** mark*
*or 60 – 4 for **1** mark*

2

(ii) one-tenth of answer to (c)(i) eg 5.5

1

(at 10°C / lower temperature):

lower rate of respiration

allow chemical reactions slower or enzymes less active
ignore breathing
do not allow anaerobic

1

worms less active / worms release less energy / worms use less energy

1

(d) (i) anomalous result / not in line with other data / does not fit the pattern

1

(ii) more representative / more reliable / can check 'repeatability' / see if get similar values / identify anomalies

ignore valid / more fair

ignore reproducible

ignore 'to remove' anomalies

do not accept more accurate or more precise

1

[10]

Q3.

(a) in yeast:

'it' equals yeast

makes alcohol / makes CO^2 / does not make lactic acid

do not allow uses / involves alcohol / CO^2

1

(b) (i) any two from:

allow amount of yeast

- volume of yeast / suspension
- volume of sugar / solution
- concentration of sugar

amount of sugar = max 1 for sugar

- temperature

(total) volume = 1 mark if no other volume

ignore concentration of yeast

2

(ii) most / more CO^2 given off with fructose **or**

'it' equals fructose

faster CO^2 production

or

faster respiration

allow faster fermentation

1

*do **not** allow aerobic respiration*

so (rate of) alcohol production will be greatest / more (with fructose)

1

[5]

Q4.

(a) (i) carbon dioxide

accept CO_2 / CO2

*do **not** accept CO^2*

1

(ii) fermentation / respiration

ignore aerobic / anaerobic

1

(b) most / more gas (produced)

*do **not** allow 'a lot'*

or

allow alternative descriptions

liquid level lowest

ignore name of gas

1

(c) (i) repeat

ignore reference to average or mean

or

compare with results of others

1

(ii) if reliable - get same / similar results

*allow same pattern but **not** pattern alone*

or

allow no anomalies

small range

ignore anomalies unqualified

1

(d) use smaller intervals

can be implied

1

around 30°C **or** between 25°C and 35°C

*do **not** allow for temperatures below 25°C above 35°C*

ignore references to sensitivity or precision (of thermometer)

*NB do at 28°C, 30°C and 32°C = **2** marks*

1

[7]

Q5.

(a) <u>person with muscle disease:</u>

allow reverse argument for healthy person

any **three** from:

NB all points are comparative except peak (point 3)
*allow use of **two** approximate figures as a comparison*

- higher resting rate **or** higher at start
- when exercise starts / then increases more / more rapidly
  accept description eg rise …. fall
- peaks (then falls)
- levels off <u>later</u> than healthy person
- higher rate during exercise
  *if no other marks awarded allow **1** mark for 'it's higher'*
- greater range

3

(b) (i) oxygen
accept adrenaline
accept O_2
*do **not** accept O, O2 or O^2*

1

(ii) cannot release sugar / glucose (from glycogen)

or

cannot store glucose / sugar (as glycogen)

1

need to receive glucose / sugar (from elsewhere)
ignore oxygen

1

for energy / respiration / cannot store energy
ignore aerobic / anaerobic

1

[7]

Q6.

(a) (i) any **three** from:
*if diet given as answer = max **2***

- age (of athlete)
- gender (of athlete)
- <u>starting</u> concentration of glycogen
- type / intensity of exercise
- length of exercise period

- number of training sessions
  *if none of these points gained amount of exercise = **1** mark*
- time interval between exercise sessions
- exercise at same time of day
  *if last four points not awarded allow time (for exercise) for **1** mark*
  ignore references to amount of energy
  ignore they are both athletes

3

(ii) any **two** from:

- intensity of exercise
- amount of exercise between sessions
- <u>starting</u> concentration of glycogen
- fitness / health
- metabolic rate / respiration rate
- amount / mass of <u>muscle</u> / physique
- aspects of diet qualified, eg amount of food eaten
  *do **not** accept amount of carbohydrate*
  *if no other marks awarded allow height / mass / weight for **1** mark*

2

(iii) (B has) less glycogen
he = B

or (B's glycogen) fell more
accept use of approximate figures

or (B's glycogen) built up less
allow other correct observations from graph eg A is lower at end of first session
ignore rate of fall

1

(b) athlete **A** (no mark)
to gain full marks 'more' must be given at least once

athlete **A** had more glycogen / **B** has less (only if A chosen to complete marathon)
*accept converse argument for **B***

1

(glycogen / glucose) used in respiration
ignore anaerobic

1

(more) energy released / available in athlete **A**

allow 'energy made'

1

and either energy used for movement / muscle action / to run
or
(extra) glycogen → (more) glucose

1

[10]

Q7.

(a) LHS: carbon dioxide **AND** water

in either order

*accept CO_2 **and** H_2O*
allow CO2 and H2O
if names given ignore symbols

*do **not** accept CO^2 / H^2O / Co / CO*
ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept $C_6H_{12}O_6$
allow C6H12O6
*do **not** accept $C^6H^{12}O^6$*

1

(b) (i) light is needed for photosynthesis

or

no photosynthesis occurred (so no oxygen produced)

1

(ii) oxygen is needed / used for (aerobic) respiration

full statement

*respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark*

2

(c) (i) (with increasing temperature) rise then fall in rate

1

use of figures, ie

max. production at 40 °C
or maximum rate of 37.5 to 38

1

(ii) <u>25 – 35 °C</u>

either faster movement of particles / molecules / more collisions
or particles have more energy / enzymes have more energy

1

or temperature is a limiting factor over this range

40 – 50 °C

denaturation of proteins / enzymes

ignore denaturation of cells
ignore stomata

1

(d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate

1

so waste of money **or** less profit / expensive

1

because respiration rate is higher at > 35 °C
or
respiration reduces the effect of photosynthesis

1

[12]

Q8.

(a) 7.15 to 7.45 am **and** 7.15 to 7.45 pm

***both** required, either order*
accept in 24 hr clock mode

1

(b) (i) 11

1

(ii) 32.5 to 33

allow answer to (b)(i) + 21.5 to 22

1

(c) any **two** from:

- more photosynthesis than respiration
- more biomass / carbohydrate made than used

allow more food made than used

- so plant able to grow / flower

accept plant able to store food

2

[5]

Q9.

(a) (i) 6 peaks in heart rate

*accept 6 increases / spikes **or** goes very high 6 times*
allow heart rate increases each time he runs

1

(ii) 2.5 / 2½

allow 2 minutes 30 seconds

*do **not** accept 2.3 / 2:3 / 2.30*

1

(b) *more / faster / a lot **must** be stated at least once for full marks*

(more) oxygen supplied / needed

allow less anaerobic (respiration)

or (more) aerobic respiration

***or** prevents oxygen debt*

1

(more) glucose / sugar / food supplied / needed

ignore feeding

1

(more) energy needed / released

allow energy produced / made

1

(more) carbon dioxide / heat / lactic acid removed (from muscles) **or** more cooling

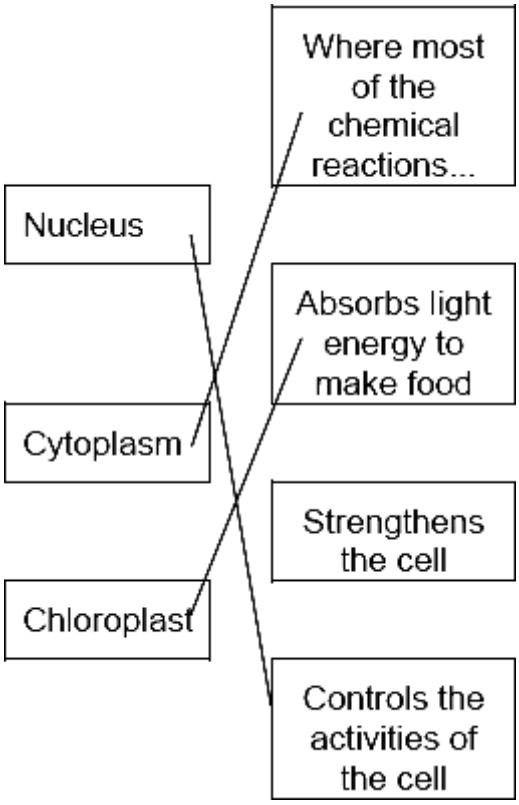
or less lactic acid formed

1

[6]

Q10.

(a)



***1** mark for each correct line*

mark each line from left hand box

two lines from left hand box cancels mark for that box

3

(b) energy

1

[4]

Q11.

(a) (i) brain

1

(ii) skin

1

(iii) 1/25 **or** 4% **or** 0.04 **or** 1 in 25 **or** 1:25 **or** 1 out of 25

allow $\frac{1000}{25000}$

1

(b) any **two** from:

- increased / high heart rate / pulse rate
  *do **not** allow pumps more blood unqualified*
- dilation / widening of <u>arteries / arterioles</u> (to skeletal muscles)
  accept vasodilation unqualified
  *do **not** accept reference to veins / capillaries*

  or
  less blood flow to other organs
- increased stroke volume / described

2

(c) *ignore references to breathing*

<u>more</u> respiration / description
or
<u>more</u> energy required **or** to provide <u>more</u> energy

1

respiration / process described → CO_2
*do **not** accept anaerobic respiration*

1

CO_2 <u>diffuses</u> into blood

1

[8]

Q12.

(a) (i) glycogen

1

(ii) respiration

1

(b) (i) 483 kJ

1

(ii) oxygen

1

(iii) dilate

1

(c) supplies more / a lot of oxygen **or** removes more carbon dioxide **or** release more energy / faster respiration

1

[6]

Q13.

(a) (i) B **or** D

1

(ii) A **or** B

1

(b) any **four** from:

more / faster must be implied at least once for full marks

- increased blood (flow)
  ignore reference to breathing
- (more) oxygen supplied **or** aerobic respiration
  *allow less anaerobic (respiration) **or** and prevents oxygen debt*
- (more) glucose / sugar / food supplied
  ignore feeding
- (higher rate of) respiration
- (more) energy needed / released
  allow made
- (more) carbon dioxide removed
- (muscles) doing (more) work **or** muscles contracting
- remove heat / cooling
- remove lactic acid **or** less lactic acid formed

4

[6]

Q14.

insufficient / no oxygen available

1

for (just) aerobic respiration

or
respires anaerobically

1

[2]

Q15.

(a) (i) C and D

1

(ii) cell wall

1

(b) (i) A

1

(ii) D

1

(c) respiration

1

[5]

Q16.

(a) microorganisms

1

(b) moist

1

(c) respiration

1

(d) roots

1

[4]

Q17.

(a) (i) 150

1

(ii) any **two** from:

accept correct use of numbers
accept pulse rate

- lower resting rate
- lower rate during exercise
- recovers faster after exercise

allow a general statement about lower rate if neither of the first two points given

2

(b) glucose

1

oxygen

1

[5]

Q18.

(a) (i) 120

1

(ii) 11 760 **or**
correct answer from candidate's answer to (a)(i)

correct answer with or without working

if answer incorrect

120 × 98 ***or***
candidate's answer to (a)(i) × corresponding SV gains ***1*** *mark*

if candidate uses dotted line / might have used dotted line(bod) in (a)(i) ***and*** *(a)(ii) no marks for (a)(i) but allow full ecf in (a)(ii) eg 140 x 88 = 12320 gains* ***2*** *marks*

2

(b) trained athlete has higher stroke volume / more blood per beat

1

same volume blood expelled with fewer beats

or for same heart rate more blood is expelled

1

(c) increased aerobic respiration

or

decreased anaerobic respiration

allow correct equation for aerobic respiration

accept don't have to respire anaerobically

1

increased energy supply / need

1

less lactic acid formed

or to breakdown lactic acid **or** less O_2-debt

1

can do more work **or** can work harder / faster / longer

accept muscle contraction for work

or less fatigue / cramp / pain

1

[9]

Q19.

(a) (i) 19 800

for correct answer ignore working or lack of working

*165 × 120 but no answer / wrong answer = **1** mark (ignore extras)*

2

(ii) any **two** from:

- for respiration
  ignore oxygen debt
- energy released
  allow energy produced
- prevents anaerobic respiration
- prevents build-up of lactic acid

2

(b) any **two** from:

- increased breathing rate(*)
- increased depth of breathing **or** deep breathing(*)
  *(*)more breathing is max **1** mark*
  ignore increase in heart rate
  allow heavier breathing
  *do **not** allow harder breathing*
- dilation of arteries / vasodilation
  allow blood vessels dilate
  *do **not** allow veins / capillaries dilate*
- blood diverted from elsewhere
  ignore name of organ

2

[6]

Q20.

(a) any **two** from:

- age
- gender
- mass

- number in group
- time

2

(b) any **two** from:

- highest (mean) mass loss on Rosemary Conley **or** Rosemary Conley most effective
- least (mean) mass loss in control group **or** mean

2

(c) (Atkins)

costs least

1

mass loss very similar to other diets **or** second highest mass loss **or** as effective as other diets

1

(d) any **two** from:

- (exercise) increases metabolic rate / respiration
  ignore sweating
- (exercise) needs / uses energy / calories
  allow burns fat / calories
  *do **not** accept energy for respiration*
- (this) energy comes from food / fat
- less food / energy/ calories converted to fat

2

[8]

Q21.

(a) A

1

(b) (i) diffusion

1

(ii) respiration

1

(iii) mitochondria

1

(iv) photosynthesis

1

[5]

Q22.

(a) A

no mark – can be specified in reason part
if B given = no marks throughout
if unspecified plus two good reasons = 1 mark

high(er) pressure in A

allow opposite for B
do not accept 'zero pressure' for B

1

pulse / described in A

accept fluctuates / 'changes'
allow reference to beats / beating
ignore reference to artery pumping

1

(b) (i) 17

1

(ii) 68

accept correct answer from candidate's (b)(i) × 4

1

(c) (i) oxygen / oxygenated blood

allow adrenaline
ignore air

1

glucose / sugar

extra wrong answer cancels eg
sucrose / starch / glycogen / glucagons / water
allow fructose as an alternative to glucose
ignore energy
ignore food

1

(ii) carbon dioxide / CO_2 / lactic acid

allow CO2 / CO^2
ignore water

1

[7]

Q23.

(a) No

no mark
if yes max 1 for correct statement

diffusion is down the concentration gradient

accept by diffusion ions would leave the root

1

to enter must go up / against the concentration gradient
or concentration higher in the root

or concentration lower in the soil

1

(b) (i) 0.9 **or** 3.25

for correct answer with or without working

if answer incorrect 1.3 ***or*** *their rate – 0.4 gains 1 mark*

or *130 – 40* ***or*** *90 gains 1 mark*

2

(ii) (uptake) by active transport

1

requires energy

more energy from aerobic respiration

1

or

more energy when oxygen is present

1

[7]

Q24.

(a) 4000

award ***both*** *marks for correct answer, irrespective of working*

1500 + 2000 + 500 gains ***1*** *mark*

2

(b) day 2 (no mark)

any **two** from:

max ***1*** *mark if correct day not identified or if no day given*

- more (water in) breath / breathing
- more (water in) sweat / sweating

  accept a lot of sweating
- less (water in) urine

  if no other marks awarded allow ***1*** *mark for more water lost on day 2*

2

(c) (i) respiration

1

(ii) cools / removes heat owtte

ignore 'maintains body temperature' unqualified

1

(iii) osmosis

1

[7]

Q25.

(a) B = rib

1

C = diaphragm

1

(b) (i) D

allow lower case

1

(ii) carbon dioxide

1

[4]

Q26.

(a) (i) A **or** C

allow lower case

1

(ii) B **or** D

allow lower case

1

(b) (i) 60

1

(ii) 4

1

(c) red blood cells

1

[5]

Q27.

(a) any **three** from:

- rose <u>rapidly</u> (during exercise) / use of approximate figures
- then more slowly (during exercise)

  accept rate (of increase) slows down
- to max 126 / at 5 minutes / end of exercise
- <u>rapid</u> fall (during recovery) **or** use of approximate numbers
- then less rapid fall / use of approximate numbers
- returned to resting rate (60 bpm) by 11 minutes

3

(b) arteries dilate / widen

accept muscle in wall relaxes

1

(c)

any **four** from:

- muscles using more energy **or** more energy released
- muscles respire faster
- supply more oxygen
- supply more glucose / sugar
- remove more CO_2
- remove lactic acid
- remove heat / to cool

do **not** accept energy produced

allow for aerobic respiration **or** to prevent anaerobic respiration

'more' needed ONCE only for full marks

4

[8]

Q28.

(a) increased speed
or harder exercise / running
→increased need / use / loss of energy

1

allow further you run / walk the more energy you need

increased mass / bigger → increased use of energy

1

(b) any **three** from:

- supply / using (more / enough) oxygen
  or get (more) oxygen in blood(*)
- remove (more) CO_2(*)
- doing (more) work
  or
  using (more) energy allow produce energy(*)
  (*)need reference to 'more' ONCE only for full marks
- for respiration
- prevent build up of lactic acid
  or prevent oxygen debt
  or prevent anaerobic (respiration)
  or allow aerobic (respiration)

3

[5]

Q29.

(a) circulation / mixing / described

1

or

temperature maintenance

supply <u>oxygen</u>

*do **not** allow oxygen for anaerobic respiration*

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

- <u>material</u> for growth
  or to <u>make</u> mycoprotein

1

(c) (heat / energy) from <u>respiration</u>

allow <u>exothermic</u> reactions

allow description eg <u>breakdown</u> 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]

Q30.

(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 CO_2, and vapour

1

(c) any **two** from:

used in respiration

provides energy

(energy) needed for movement / running / muscle action

2

[6]

Q31.

in correct sequence:

breathing

1

diffusion

1

respiration

1

[3]

Q32.

(a) respire

1

oxygen / glucose
glucose / oxygen
} each once only

2

blood

1

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

2

[6]

Q33.

(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 debt

lactic acid broken down to CO_2 and water **or** lactic acid changed into glucose

4

[7]

Q34.

(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 cm^3 to 127 cm^3*

1

(iv) 1ncreased / 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]

Q35.

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]

Q1.

(a) (i) plotting values for pulse rates;

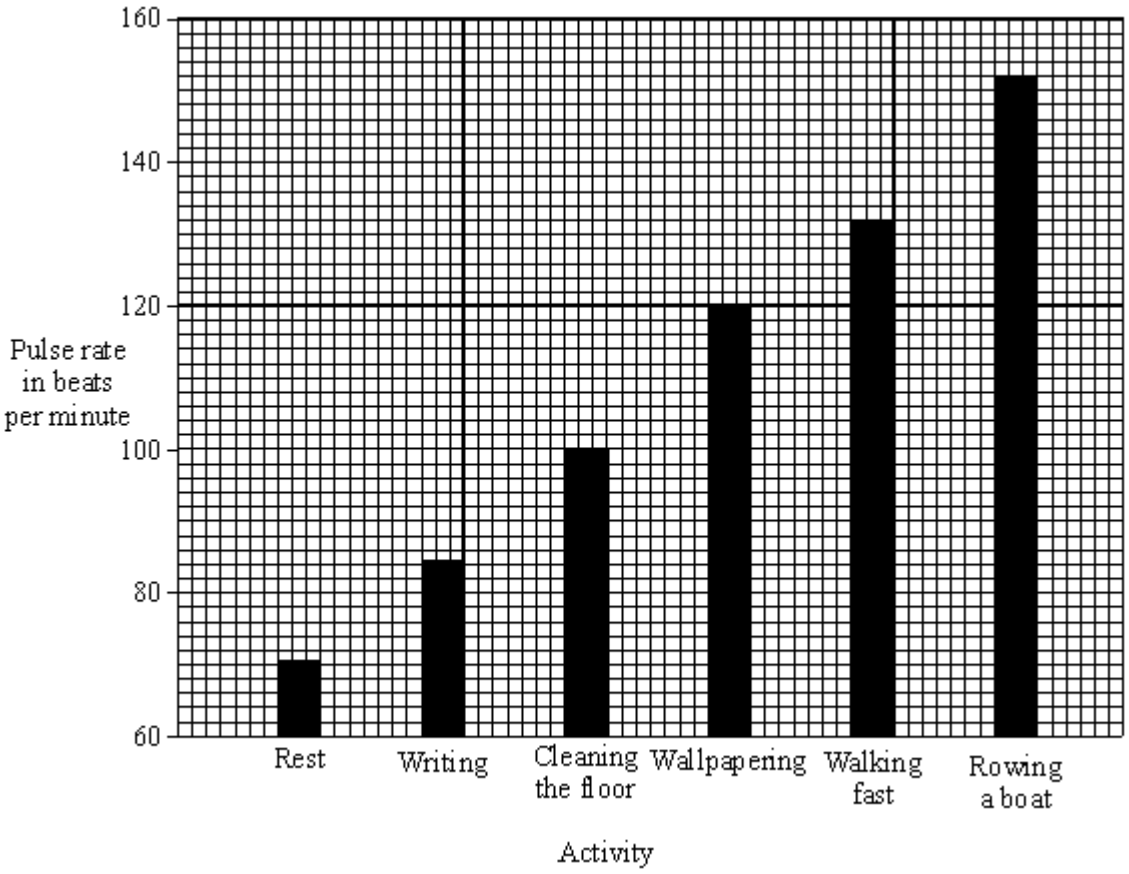
2 marks- minus 1 mark for each error to a maximum of 2

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]

Q2.

X – oxygen

accept O_2

Y – carbon dioxide

accept CO_2

[2]

Q3.

(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

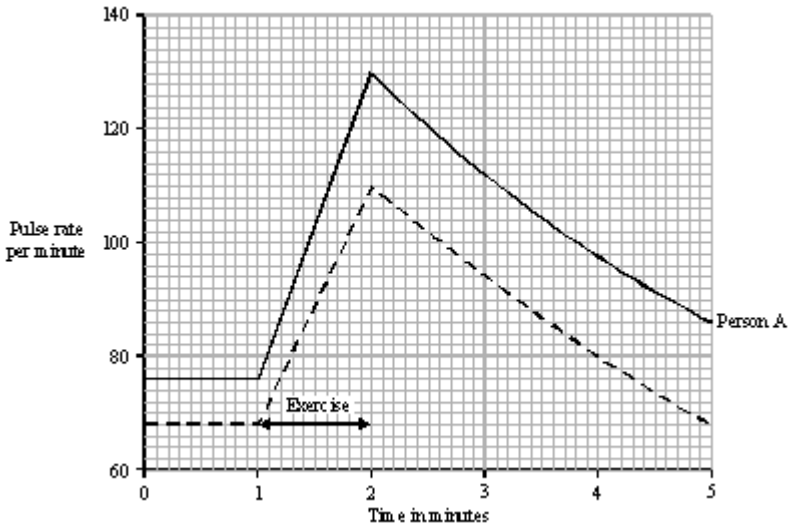
(ii) 86 (per minute);

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]

Q4.

(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 CO_2 (in the blood) rises;
increased breathing to remove excess CO_2;
increased oxygen supply to muscles;
or increased breathing takes in more O_2

or increased heart rate takes more O_2 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)/O_2 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]

Q5.

(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]

Q6.

(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]

Q7.

(a) oxygen,
carbon dioxide or water (vapour)
for 1 mark each

2

(b) idea of more air per breath/deeper breaths
for 1 mark

1

(c) (i) respiration
for 1 mark

1

(ii) carbon dioxide,
water
for 1 mark each

2

(iii) more energy required,
for increased muscular activity
for 1 mark each

2

[8]

Q8.

(a) more energy needed,
for increased muscular activity
for 1 mark each

2

(b) increased sweat production,
evaporation of sweat cools body,
vasodilation OWTTE,
more heat loss (by radiation)
for 1 mark each

4

[6]

Q9.

(i) the higher the rate of oxygen consumption, the shorter the time taken to complete
for 1 mark

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]

Q10.

(i) increase in CO_2 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, in crease in % CO_2 results in volume of each breath increasing without increase / little increase in number of breaths

each for 1 mark

2

[4]

Q11.

(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]

Q12.

(i) 0.25 × 100 / 25

gains 1 mark

but
1%

gains 2 marks

2

(ii) muscle contraction / limb movement / moving around / chewing
heartbeat / breathing / internal muscle activity
maintaining body temperature / keeps body warm
active uptake synthesising substances (*reject* growth)

any three for 1 mark each

3

[5]

Q13.

(a) 11

accept 10.5 – 11.5

1

(b) ideas of

increase / rises

1

frequently / often

1

energetically / violently

1

[4]

Q14.

(a) falls

1

from 0.25

1

to 0.19

but by 0.06 gains two marks

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

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) <u>more</u> oxygen

1

[6]

Q15.

any **three** from:

heat produced by muscles

<u>during</u> exercise

accept <u>when</u> 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]

Q16.

(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]

Q17.

(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 respires 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]

Q18.

(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]

Q19.

(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]

Q20.

(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]

Q21.

(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]

Q22.

(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]

Q23.

(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 O_2

1

lactic

1

[8]

Q24.

(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]

Q25.

(i) respiration

1

(ii) oxygen **or** O_2
*do not accept O **or** O^2*

1

(iii) carbon dioxide **or** CO_2
do not accept CO^2

1

[3]

Q26.

(a) to transfer / provide / give release energy
***or** production of ATP / adenosine triphosphate (molecules)*
accept to give heat

1

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

Q27.

(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]

Q28.

(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]

Q29.

(a) *idea*
O_2 increases
CO_2 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 cm^3/min more
gains 3 marks

or 2½ times more

3

[9]

Q30.

(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]

Q31.

(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]

Q32.

(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]

Q33.

(a)
- appropriate scales (> halfway along each axis)
- all points correctly plotted to better than ½ 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]