AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



MARK SCHEME

4.4.2 RESPIRATION (PACK 4)

SCORE	PERCENTAGE
/161	%

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Q1.

(a) breathing rate when walking is twice that at rest

allow breathing rate when walking is 12 (breaths / minute) more than at rest

1

breathing rate when jogging is 5 times that at rest

allow breathing rate when jogging is 48 (breaths / minute) more than at rest

1

breathing rate when jogging is 2.5 times that when walking

allow breathing rate when jogging is 36 (breaths / minute) more than when walking

1

*allow for **1** mark if no other marks gained:*
breathing rate at rest is 12 (breaths per minute),
breathing rate when walking is 24 (breaths per minute) and breathing rate when jogging is 60 (breaths per minute)
or
breathing rate increases with increasing activity
***max 2** marks if written in terms of heart rate*

(b) (breathing rate increases)

to supply more oxygen / O_2
or
to supply oxygen / O_2 faster

allow to remove more carbon dioxide / CO_2
or
to remove carbon dioxide / CO_2 faster
*do **not** accept incorrectly written formulae*

1

for (aerobic) respiration
or
to reduce anaerobic respiration
or
to reduce lactic acid build up

1

(so) that more energy is transferred / released
or
(because) more energy is required

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

1

reference to more / faster required at least once for full marks

(c) right ventricle / side of the heart pumps (blood) to the lungs

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1

left ventricle / side of the heart pumps (blood) to the body

1

*if no other marks scored allow **1** mark for one side pumps blood to the lungs and the other side pumps blood to the body*

(d) any **one** from:

- (the left ventricle) has to pump blood further (than the right ventricle)

  allow (the left ventricle) has to pump blood all around the body

- (the left ventricle) has to pump blood with a greater force (than the right ventricle)

  allow (left ventricle) has to pump blood harder

- (the left ventricle) has to pump blood at a higher pressure (than the right ventricle)

1

there must be a comparative statement

(e) any **one** from:

- strengthens heart (muscle)
- reduces chance of another heart attack

  ignore prevents / no heart attacks

- reduces / controls weight
- improves circulation

  allow decreases chance of fatty deposits
  ***or** fat building up (in arteries / blood vessels)*

  allow reduces resting heart rate

1

[10]

Q2.

(a) one X and one Y chromosome and 9 pairs of other chromosomes

1

(b) any **three** from:

- (called) meiosis

  correct spelling only

- DNA / chromosomes replicate
  or
  DNA makes a copy
- two divisions to form 4 cells
- so only 1 set of chromosomes per cell

  allow cells are haploid
  ignore half the DNA

- (daughter cells / gametes) are all genetically different

  *if no other mark awarded allow **1** mark for forms gametes / cells which are all different*

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or *only happens in testes and (embryonic) ovaries*

3

(c) (meiosis will not work because) number of chromosomes cannot halve

allow chromosomes cannot form pairs
allow chromosomes cannot split up evenly

1

(d) do not use energy in reproduction

1

so more (energy) available to synthesise proteins

allow other correct molecules or cell components

1

allow converse if clearly describing diploid oysters

(e) any **two** from:

- global warming may be raising temperature of water and killing oysters
- pollutants in the water may be toxic and kill the oysters

or

increased acidity of the oceans is killing oysters

allow correctly named pollutant with reason

- new competitors / triploid oysters are using up the normal food source
- new pathogens may be causing diseases
- new predators eating oysters

ignore over harvesting

2

(f) **Level 3:** A judgement strongly linked and logically supported by a sufficient range of correct reasons is given.

5–6

Level 2: Some logically linked reasons are given. There also may be a simple judgement.

3–4

Level 1: Relevant points are made. They are not logically linked.

1–2

No relevant content

Indicative content

for:

- oysters are available to eat all year **so** eating oysters has become very popular
- cheaper to produce **so** more food for expanding population
- oysters grow faster **so** more oysters for supermarkets / restaurants or more profit for farmers
- stocks are replenished each year **so** more sustainable fishing
- they can harvest / sell all year **so** more stable and profitable for oyster farmers

against:

- carcinogen put into environment / oysters **so** may enter the food chain

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or cause cancer in humans
- bigger triploid oysters may outcompete the smaller native diploid oysters **so** upset balance of the ecosystem / cause extinction
- people may not buy / eat them because they have used a carcinogenic chemical **so** reduced profit for farmers / suppliers / supermarkets / restaurants
- farmers have to buy new seed oysters every time **so** more expensive

other content:
- shouldn't be eating the oysters until they are thoroughly tested
- should be looking for alternative ways to get triploid oysters
- should stop using triploid oysters until the effect on the (marine) environment is known
- would replace lost oyster beds **but** could change the ecosystem
- oysters available to eat all year **but** probably do not taste the same or have the same flavour

[15]

Q3.

(a) CO_2

1

(b) carbon dioxide

ignore formulae
ignore carbon oxide
*do **not** accept carbon monoxide*

1

(c) 46.2 (kg)

allow 46 (kg)

1

(d) (fossil / hydrocarbon) fuels burn / combust

allow named fossil fuels

1

in a limited supply of oxygen / air

allow lack of oxygen / air

1

*an answer of incomplete combustion gains **2** marks*

(e) red blood cells

1

(f) cell death

1

decreased respiration rate

1

(g) any **one** from:

ignore breathing problems

- damages buildings / bridges / statues

allow damages iron / metal / limestone structures

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- harms / kills plants / trees

- harms living organisms in ponds / rivers / lakes

  allow harms aquatic organisms

1

[9]

Q4.

(a) trachea

1

(b) any **one** from:

- can see more detail in lungs

  ignore gives clearer image

- you can see the bronchus / bronchioles / soft tissues

  ignore bones

  allow it doesn't use ionising radiation
  allow X-rays can cause cancer / mutation

1

(c) you can see the ribs / bones

allow cheaper
allow takes less time

1

(d) any **three** from:
(aerobic)

- uses / needs / requires oxygen (and anaerobic does not)
- transfers more energy (than anaerobic)

  allow releases more energy (than anaerobic)
  *do **not** accept energy is created / produced / made*

- produces carbon dioxide / water (anaerobic does not)
- does not produce lactic acid (anaerobic does)
- does not cause an oxygen debt (anaerobic does)

  *allow aerobic takes place in mitochondria **and** anaerobic takes place in cytoplasm*

  allow converse in terms of anaerobic

3

(e) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

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Indicative content

(stopping smoking will improve health because):
- smoking is a risk factor for cardiovascular disease
- raises blood pressure
- increases cholesterol and / or lowers HDL
- increases atherosclerosis **or** thickened artery walls
- increases the risk of blood clots forming
- increases risk of stroke

- smoking is a risk factor for lung cancer
- as it can cause mutations
- caused by carcinogenic chemicals in smoke (tar)
- leading to uncontrolled growth of cells

- smoking damages alveoli
- causing the surface area of the alveoli to decrease
- causes emphysema / COPD
- causes shortness of breath **or** reduces gas exchange

- chemicals / tar / nicotine in the smoke irritate / inflame the bronchi / lung / bronchioles
- which damage the cilia
- causes goblet cells to secrete more mucus
- causes shortness of breath **or** reduces gas exchange
- causing chronic bronchitis **or** increases risk of infections

- carbon monoxide is produced
- which is toxic / poisonous
- binds / attaches to haemoglobin / Hb
- so oxygen carrying capacity of blood is decreased

[12]

Q5.

(a) 36 000 (cm^3)

1

(b) 11600 / 1200

1

9.66666r

allow any number of decimals

1

(c) muscles need more energy (for contraction)

1

(so) more oxygen / glucose needed

need at least one reference to 'more' for full marks

allow so more carbon dioxide / thermal energy needs to be removed

1

(for) increased respiration

1

(d)

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Level 3: Relevant points (differences / functions) are identified, given in detail and linked logically to form a clear account.	5-6
Level 2: Relevant points (differences / functions) are identified and there are attempts at logical linking. The resulting account is not fully clear.	3-4
Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1-2
No relevant content	0
Indicative content • artery has a thicker wall • (because) artery has to withstand higher pressure • artery has thicker layer of elastic tissue / fibres • (so) it can stretch • (so) artery returns to original size / shape • artery has thicker layer of muscle • to maintain a force on the blood • vein has valves • (valves) prevent backflow of blood • artery carries blood away from the heart • vein carries blood towards the heart ignore references to oxygenated / deoxygenated blood	

6

[12]

Q6.

(a) any **two** from:

- synthesis of new molecules
  allow named molecule eg starch / glycogen / cellulose / lipids / fats / proteins / hormones / antibodies
- for active transport
- to keep warm (in mammals / birds)
  allow description
  allow to keep warm (in animals)
  allow for movement (in animals)

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allow for transmission of nerve impulses (in animals)

2

(b) mitochondria / mitochondrion

1

(c) both occur without oxygen

1

both release (a small amount of) energy

1

muscle cells produce lactic acid but plant cells produce ethanol

1

muscle cells do **not** produce carbon dioxide but plant cells do

marks can be awarded from correct word or balanced symbol equations

1

(d) the amount of oxygen needed to react with the lactic acid formed

allow the amount of oxygen needed to break down

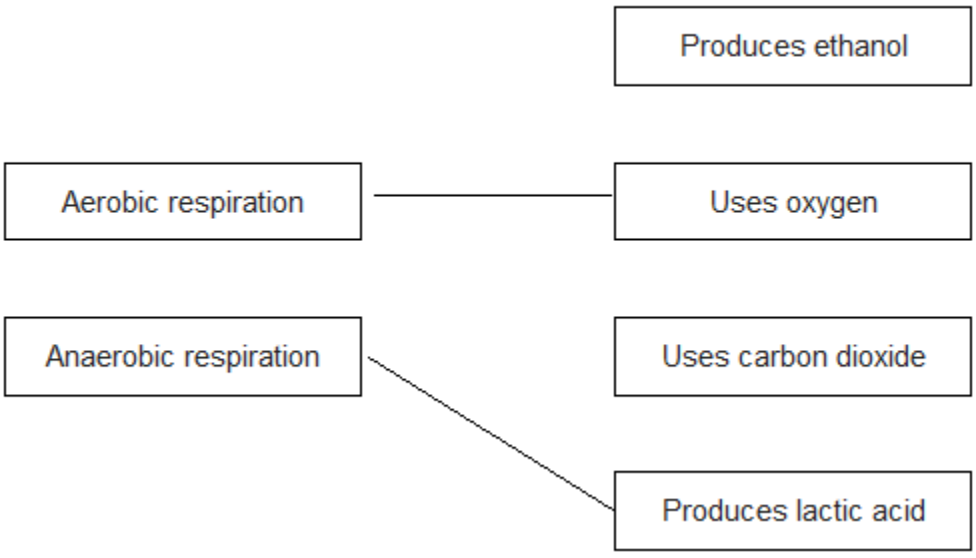
or *oxidise the lactic acid*

1

[8]

Q7.

(a)



an extra line from a LH box negates that mark

2

(b) any **one** from:

- not enough oxygen present (for aerobic respiration)
- more energy required for exercise (than can be transferred by aerobic respiration)

1

allow named example for exercise

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(c) produces carbon dioxide

1

produces ethanol

1

plus any **two** from:

- (carbon dioxide) makes bread rise
- (carbon dioxide) makes beer / cider / (some) wines fizzy
  allow for alcoholic drinks / named drink
- (ethanol) is the alcohol in beer / cider / wine / spirits

2

[7]

Q8.

(a) 66 (beats per minute)

1

(b) heart rate increased

1

(c) 4

1

(d) any **two** from:

- resting heart rate was lower
- heart rate did not increase as much
- heart rate did not increase as fast
- heart rate returned to normal sooner

2

(e) **Level 2 (3–4 marks):**
A detailed and coherent explanation is given, which logically links changes in the body during exercise to reasons for these changes.

Level 1 (1–2 marks):
Discrete relevant points made. Links may not be made.

0 marks:
No relevant content

Indicative content

Changes:
- breathing rate increases
- deeper breathing
- (body) temperature increases
- sweating occurs
- muscle fatigue
- vasodilation

Explanations linked to correct change:
- to provide more oxygen
- to remove carbon dioxide faster
- (as) more energy required

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- (so) increased respiration
- (so) more energy transferred
- for movement or contraction of muscles
- some energy warms the body
- (sweating) cools the body down
- (by) evaporation of sweat

4

[9]

Q9.

(a) control

1

to check that the indicator colour does not change on its own
or
to check any changes in colour are due to the organisms

1

(b) (tube) **E**

1

most carbon dioxide

1

(due to) only respiration occurring

allow no carbon dioxide used for photosynthesis

*allow **1** mark **max** if chose tube **D** and give a correct reason*

1

(c) the amount of carbon dioxide produced by respiration equalled amount absorbed for photosynthesis

1

[6]

Q10.

(nitrate) ions are absorbed by active transport

1

(active transport) is the movement of ions against the concentration gradient

allow (active transport) is the movement of ions from a dilute to a more concentrated solution

1

(active transport) requires energy from respiration

1

(respiration) requires oxygen

1

no / little oxygen / air in water-logged soil

1

[5]

Q11.

(a) reduces biodiversity

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1

peat is being used faster than it forms

allow peat is non-renewable

1

(b) decay / decomposition / rotting of peat

1

by microorganisms / bacteria / microbes / fungi / decomposers introduced when peat is mixed with air

1

that respire using substances in peat as reactant

1

and using oxygen that is introduced when peat is mixed with air

1

[6]

Q12.

(a) (to) stop them falling in the solution

or

to stop them drowning (in the solution)

1

(b) **Level 2 (3–4 marks):**
A detailed and coherent explanation is given of how the droplet moves, clearly and logically linked to the process of respiration.

Level 1 (1–2 marks):
Simple statements are made about movement of the water droplet, but any attempts at explaining the reason or linking the movement to the process of respiration are unclear
and poorly structured.

0 marks:
No relevant content

Indicative content

- water droplet moves towards the maggots / boiling tube

Explanation:

- the oxygen in the boiling tube is used up in respiration
- (and) the carbon dioxide released from respiration is absorbed by solution **A**
- which causes a pressure difference
- so air is drawn into the tube
- bringing the water droplet with it.

4

(c) *x* axis: Temperature in °C

both needed for the mark

y axis: Rate of respiration in units

1

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(d) repeat the experiment at 30 °C

1

(e) 10.5

allow range 10.4–10.8

1

[8]

Q82.

(a) (i) 214 (billion tonnes)

*allow **1** mark for reading 122 and 92 correctly*

*allow **1** mark for the correct addition of incorrect readings*

2

(ii) 18.35

allow 18.4

*do **not** allow 18.3*

1

(b) (i) (only) a small mass of carbon (dioxide) is released from burning fuels (compared to other processes)

allow the carbon (dioxide) released from other processes / respiration and decomposition is (much) greater

1

(ii) any **two** from:

- (more) plants would absorb (more) carbon (dioxide)
- (due to more) photosynthesis

an idea of more is needed at least once

- fewer animals would release less carbon (dioxide)
- (due to less) respiration (in animals).

an idea of a reduction is needed at least once

ignore references to oxygen

2

[6]

Q83.

(a) glucose ⟶ ethanol + carbon dioxide

allow sugar for glucose

allow correct formulae

ignore attempts at balancing

1

(b) (i) filtration

1

(ii) (fractional) distillation

allow evaporation then condensation

1

[3]

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Q84.

any **six** from:

*only credit release of carbon dioxide **once** when linked to a correct process*

ignore references to burning

- (plants) photosynthesise
- *(plants)* take in carbon dioxide
- *(plants)* produce carbohydrates / fats / proteins

  accept produce glucose
- (carbon compounds transferred by) feeding
- respiration
- breaks down carbon compounds / carbohydrates

  accept glucose
- releases carbon dioxide
- organisms die / produce wastes / *excrete*
- (which are) decomposed / decayed by microorganisms

  allow broken down

  allow bacteria / fungi / microbes / decomposers
- (which) release carbon dioxide

[6]

Q85.

(a) light → chemical

both answers needed

1

(b) (i) 8.3 / 8 / 8.3 recurring

*allow 4/48 or 2/24 or equivalent or 0.08(3) for **1** mark*

2

(ii) any **three** from:

- respiration

  *do **not** allow **for** respiration*

  allow (lost as) heat
- to keep warm

  ignore evaporation / sweating
- for movement
- in waste materials / urea / faeces / carbon dioxide

  allow excretion
- in eggs

  ignore growth

3

[6]

Q86.

(a) (temperature) thermometer or <u>temperature</u> probe / sensor

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1

(oxygen concentration) <u>oxygen</u> probe / sensor / meter

1

(b) (i) 13 (arbitrary units)

allow values in the range 12.5 – 13.5

1

(ii) the greater the concentration of oxygen the faster the rate of decay

1

(c) line drawn below line on graph following similar pattern

line starts at 0% oxygen concentration and from 0 – 3 arbitrary units

1

(d) microorganisms / bacteria / fungi

accept any correct organism

allow decomposers / detritivores or named example e.g. worms

1

plants

allow crops or named plants

1

<u>respiration</u>

1

[8]

Q87.

(a) microorganisms / bacteria / fungi

allow correct named organisms

allow detritus feeders / decomposers / worms

1

break down / digest / feed on (dead organisms)

accept use carbohydrates / glucose

allow decomposes

ignore decay / rot

1

(and release carbon dioxide when they) <u>respire</u>

*do **not** allow respiration if linked to leaves / dead organisms*

1

(b) any **two** from:

- the higher the temperature the faster the rate of decay

allow faster / more carbon dioxide for faster rate of decay

- the higher the oxygen concentration the faster the rate of decay

allow faster / more carbon dioxide for faster rate of decay

- the rate increases faster (with increasing oxygen concentration) at 20 °C
(than 15 °C)

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2

[5]

Q88.

A – respiration

ignore breathing

1

B – feeding / eating

allow consumption / ingestion / feeds
ignore nutrition / food
*do **not** accept digestion*

1

C – photosynthesis

1

D– combustion / burning

1

[4]

Q89.

plants absorb CO_2 for photosynthesis

ignore carbon

1

all organisms / any named organism respire(s) and release(s) CO_2

ignore breathing
ignore carbon

1

any **four** from:

- carbon compounds / named compound made by plants
- plants eaten by animals
- dead organisms / faeces are decomposed / decayed
  allow broken down
- by bacteria / microorganisms
- dead plants and animals (may) form fossil fuels
- when (fossil) fuels are burnt they release CO_2 into the air

4

[6]

Q90.

(a) (i) photosynthesis

allow phonetic spellings

1

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(ii) respiration

allow phonetic spellings

ignore breathing / decay

1

(b) any **two** from:

- burn / use less fossil fuels
  or
  reduce industrial processes
  or
  use cars less

  allow cycle / use buses / walk / trains / public transport

  allow stop for reduce in all cases

- reduce deforestation

  accept named example

  or

  plant more trees

  allow plants

- use alternative sources of energy

  accept solar / wind / nuclear / hydroelectric / wave / tidal / geothermal

  ignore renewable / biomass

- trap CO_2 in sedimentary rocks / underground / under sea
  or
  carbon capture / CCS

- rear less cattle / animals

  allow eat less meat

  allow <u>reduce</u> growth of human population

  ignore reduce the human population

2

[4]

Q91.

read 'the gas' or 'it' as carbon dioxide

(plants) photosynthesise

1

(plants) absorb <u>carbon dioxide / CO_2</u> (from the air)

allow take in / use <u>carbon dioxide / CO_2</u> (from the air)

1

(overall) <u>more carbon dioxide / CO_2</u> is being released into the air than is being removed

*allow 470 (billion tonnes) released **but / and** 450 (billion tonnes) taken in*

1

(by) <u>respiration</u> (by all organisms / any named organism)

ignore breathing

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ignore carbon

1

(and) combustion / burning

ignore carbon

1

(so) amount of carbon dioxide / CO_2 in air is increasing

allow 20 (billion tonnes) of carbon dioxide / CO_2 added to air each year

1

[6]

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Q1.

(a) This question was set at standard demand. 50% students achieved one mark. This was usually for giving three correct graph readings, without comparisons. 11% of students achieved more than one mark.

(b) 62% of students achieved at least one mark. This was usually for saying breathing rate increased in order to supply more oxygen. Some students referred to changes in heart rate, rather than breathing rate. Only a few mentioned that more energy would be required during increased activity.

Some who did refer to energy used poor terminology, for example to produce more energy, which was not allowed.

(c) 16% of students achieved a mark for this question. Students confused which side of the heart pumped blood to the lungs or to the body. Others thought the lungs pumped the blood. Quite a few students referred to oxygenated and deoxygenated blood but did not include sufficient detail to gain marks.

(d) The question asked why the wall of the left ventricle is thicker than that of the right ventricle. Therefore a comparison had to be implied. 19% of students achieved this mark. A common incorrect idea was that the left ventricle pumped more blood than the right ventricle.

(e) 27% of students achieved this mark, usually for saying that exercise would strengthen the heart muscle. Saying that exercise would prevent a heart attack was ignored. The idea of reducing the chance of another heart attack was needed.

Q2.

As expected with this question being higher demand, students generally achieved lower marks. Some excellent answers were seen where students were able to access knowledge from different parts of the specification as well as use information from the question stem and their own wider reading to express complex concepts.

(a) This was not a straightforward knowledge question as students needed to use logical thinking as well as knowledge of chromosomes to work out the correct alternative. 50% of students arrived at the correct response. Many realised that there would be one X and one Y chromosome but their maths let them down when they computed that only eight more pairs would be needed.

(b) A large number of students understood meiosis was the type of cell division and many students could not spell it correctly. Being able to understand the differences in mitosis and meiosis is crucial as is being able to correctly spell all keywords. 28% of students achieved two or three marks.

(c) Students seemed to struggle with the idea that meiosis created four daughter cells from the two divisions, although they did tend to identify that the cells would be haploid. Many just stated the cells would be not identical rather than being genetically different.

The majority of students found it difficult to transfer their knowledge of humans and their 23 pairs of chromosomes to oysters with ten pairs and so their answers were confused. 19% of students achieved the mark here.

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(d) While students were able to note that triploid oysters didn't spend time reproducing, very few related this to energy. Many went down the route of not needing time to look for a mate. The few that did identify energy and reproduction (6% of students) rarely linked the energy available to synthesising proteins, and instead going with vague references to 'growth' which is insufficient at this level.

(e) Students had the idea that global warming, pollutants, competition or predators could be involved, but rarely gained credit as they did not express this with the necessary high demand biological detail required to explain how it would lead to a reduction in population.

Key points were generally missing such as toxic pollutants and new predators or pathogens. Some students mentioned disease but did not relate it to pathogens. 3% of students achieved full marks.

(f) This 'extended response' question was targeted at grades 6–9. Many students were able to access level 1 (43%) and level 2 (27%). It served its purpose of allowing the higher-attaining students to perform well, while not discouraging lower-attaining students from answering, and very few students made no attempt.

It was felt that students engaged with the opportunity to have an opinion about ideas on whether supermarkets and restaurants should be allowed to stock a product which may have a link to a carcinogen.

Q3.

(a) 67% of students could identify the correct formula for carbon dioxide.

(b) 60% of students could name the molecule shown as carbon dioxide.

(c) Students found it difficult to use a percentage calculation in this way. Many incorrect answers of 4620 were seen, rather than 46.2 or 46.

(d) Few students used the term incomplete combustion or described the process. 5% of students achieved full marks. Many incorrect answers stated carbon monoxide comes from fuels unqualified.

(e) 74% of students realised that red blood cells would be the component of the blood most affected by carbon monoxide.

(f) 54% of students could identify two effects a decreased concentration of oxygen could have on body cells. Despite being asked to tick two boxes, 10% of students only ticked one box. The number of ticks required for a multiple choice question is given in bold font.

(g) 30% of students could give a problem caused by acid rain. Vague answers regarding harms the environment, or pollutes, were not awarded the mark.

Q4.

Foundation

(a) 57% of students correctly identified the trachea.

(b) Many students answered in terms of the x-ray 'only showing bones' which was ignored as a clear advantage was required. Those students who did look for an advantage generally stated 'it was clearer' which was insufficient. However, 18% of

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students did recognise that the image was either more detailed or gave a specific example of tissues that could be seen.

(c) This was well answered particularly with reference to ribs. Many students seem to be familiar with the problem of a punctured lung due to broken ribs. Very few students mentioned it being cheaper.

(d) 30% of students had the depth of understanding of respiration required to achieve any credit for this question. Many referred to the idea of energy being produced which negated the second marking point.

Most answers that achieved a mark were about the need for oxygen in aerobic respiration or the production of carbon dioxide. There were some good responses referencing the location of each: mitochondria and cytoplasm.

(e) This 'extended response' question discriminated well. 57% of students were able to access level 1, and 21% of students spread across levels 2 and 3 by provided there was logical linking. The most common were tar causing breathing problems or smoking having something to do with cancer. Some mentioned the reduced oxygen carrying capacity of blood in smokers but did not know what caused it.

There were many vague level 1 answers seen. There did seem to be a lack of understanding and knowledge about the components of cigarettes and consequently how these affect the human body. Although most students answered the question in terms of the dangers of smoking, as opposed to how giving up smoking would benefit an individual, this was acceptable.

Higher

(a) 79% of students correctly identified 'trachea' here, with 'bronchus' the most common incorrect alternative.

(b) Both the scan and the X-ray show clear images so 'clear' was insufficient. The scan shows more detail. Answers in terms of not using X-rays or avoiding problems associated with ionising radiation were also allowed. 29% of students achieved this mark.

(c) 59% of students were able to answer this question correctly.

(d) 18% of students achieved all three marks in this question. Common misconceptions included:

- anaerobic respiration **needs** carbon dioxide / lactic acid
- anaerobic respiration only happens in plants
- confusion between respiration and breathing
- the idea that aerobic respiration **needs** carbon dioxide and anaerobic **needs** lactic acid
- aerobic respiration **produces** oxygen / glucose
- energy is made, created or produced.

(e) 5% of students were able to construct a clearly sequenced, correct account in this 'extended response' question. Much of what was seen was colloquial, e.g. 'smoking rots the lungs', 'tar clogs lungs'.

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Smoking is indirectly linked to a considerable range of health problems which students are taught or research for themselves. It is important however that they are aware of the clear-cut examples given in the specification.

93% of students were able to achieve at least one mark, and 32% of students gave level 2 responses.

Q82.

(a) (i) Just over a third of the students gained full marks for this question. 1 mark could be gained for correctly reading 122 and 92 from the graph. Incorrect readings that were correctly added together could also gain 1 mark. This highlights the importance of showing working for all calculations, no matter how simple the calculation may appear to be.

(ii) Some students attempted to write out the number in full, or in standard form, but could only gain the mark if they had deleted billion from the answer line. There were some avoidable errors made, such as writing 1.835 instead of 18.35. Others divided 5 by 3.67 instead of multiplying the numbers together.

(b) (i) Students were instructed to use information given in the graph to suggest why some scientists do not think that burning fuels is the main cause of carbon dioxide in the atmosphere. Many said that respiration and decomposition released more carbon than burning fuels to gain the mark. If figures were quoted, a comparison was needed. Some students gave confused responses about photosynthesis, which did not answer the question which was about burning and the release of carbon dioxide.

(ii) Students had to suggest how eating less food from animals and eating more food from plants could reduce the amount of carbon dioxide in the atmosphere. Credit could not be gained just for mentioning respiration or photosynthesis alone. Clear statements as to whether these processes would occur more or less were needed, and how this would affect the amount of carbon dioxide absorbed or released. Many students linked in to the idea of decomposition of dead organisms, which was ignored. Some spoke about carbon dioxide being produced by the meat production processes, or from cooking the meat, which was also ignored. Others focused their responses on oxygen, which did not answer the question.

Q83.

(a) This question was very poorly answered with hardly any students being able to give the correct word equation for the fermentation of sugar, which is detailed in the specification. Many equations were badly written, and students did not appear to know the basic rules. For example, an equals sign was used instead of an arrow; a sequence of reactions was presented with arrows between each stage; reactant(s) and products were not on the correct sides of the equation. Many students added yeast and water to the reaction. If these were written on both sides of the equation they were ignored, as they would cancel each other out. However, they were usually just added as reactants. The most common error, for those students who made a reasonable attempt at the word equation, was to omit carbon dioxide as a product. They just gave ethanol. Others gave a correct equation for the hydration of ethene. Students should be taught the difference between a word equation and a symbol equation, and be discouraged from combining the two.

(b) (i) Filtration would be used to separate the yeast from ethanol and water. Some said ‘distillation’ or ‘evaporation’ which were both ignored. Many

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students displayed a lack of knowledge of technical terms. The equipment to be used was often named as a sieve and words such as ‘colander’ were also seen. Others suggested using a funnel but made no reference to filtering. Others gave descriptions of decanting but did not name the process.

(ii) The question asked how ethanol could be separated from the mixture of ethanol and water. There were many references to evaporating the ethanol, but to gain the mark students had to also say how the ethanol would be collected. Many thought that boiling the mixture would evaporate the water first and leave the ethanol behind.

Q84.

The question was generally well answered and discriminated very well with the full range of marks being awarded in roughly equal proportions. Students answered the question in a variety of ways. Some described processes in a food chain, talking mainly about feeding and decomposition, whilst other, more able students, gave a full description beginning with photosynthesis. Some less able students did not restrict their responses to the woodland community and described the burning of fossil fuels in power stations, removal of timber to make paper, humans burning trees and carbon dioxide being absorbed in the oceans.

Marks were frequently missed when students referred to plants and animals breathing, rather than respiring. Confused statements such as “Plants and animals give out carbon dioxide during photosynthesis”, or “Carbon dioxide is given out during respiration and photosynthesis” meant that marks were lost. Students need to organise their answers logically, for example by referring to photosynthesis and respiration as separate ideas.

Q85.

(a) Both forms of energy were needed to gain 1 mark. Many students mentioned light, but did not say it was transferred into chemical energy, so did not gain the mark. Many said glucose or stored energy instead of chemical.

(b) (i) Candidates either understood how to calculate the percentage by using the growth and input energies or had no idea. Many students gave an answer of 12% because they had incorrectly divided 48 by 4. Errors were often made in the rounding of numbers, e.g. 8.4% instead of 8.3, but they could still gain 1 mark if they had shown correct working. Many tried to add both the input energy and total output energy, others just subtracted different energies from each other.

(ii) The question was generally well answered. Some did not gain the first marking point, respiration, because they said energy was needed **for** respiration. Many mentioned heat, movement and various wastes. ‘In eggs’ was rarely seen.

Q86.

(a) Most students gained a mark for thermometer, but a variety of unusual suggestions were made for measuring the oxygen concentration. An oxygen probe, oxygen sensor or oxygen meter was needed. Oxygen detector was a common answer which was insufficient.

(b) (i) The vast majority of students correctly read the graph and gave an answer of 13 arbitrary units.

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(ii) Although the question was well answered by most students, others did not clearly state what was changing. They just said as the percentage increased the arbitrary units increased, which was not creditworthy. Students should use the information as it is written on the graph to avoid making errors. Several students thought that increasing the concentration of oxygen decreased the rate of decay.

(c) A third of the students correctly drew a line representing the rate of decay at a lower temperature, but others drew a line above that for 20 °C. Some started their line on the x-axis, or drew a line that followed the pattern of the printed curve, but then showed the line dropping down towards the end. Neither of these gained credit. Some students had multiple lines visible – this may have been because they drew the lines in pen and so could not erase errors. Whilst text should always be written in black ink, graphs can be drawn in pencil.

(d) Many students gained a mark for either stating that microorganisms or bacteria break down dead organisms, or for saying the products of decay helped plants to grow. Some students said that the carbon dioxide was a product of photosynthesis or combustion of fossil fuels. Although carbon dioxide is a product of combustion this did not answer the question, which was about decay processes. Students should always read the stem of each question carefully.

Q87.

(a) Some students made a reasonable attempt to answer this question and gained a mark for saying that decay was brought about by microorganisms, bacteria or a correctly named organism. Some went on to say the microorganisms broke down or fed on the dead organisms, although a lot only referred to decay which was given in the question so was not creditworthy. Respiration was frequently mentioned in relation to the release of carbon dioxide, but if students said it was the leaves or dead organisms that respired the mark could not be gained. Some students gave detailed descriptions of photosynthesis in relation to carbon dioxide and oxygen, but did not answer the question which required carbon dioxide to be linked to the decay process.

(b) One of the marks for this question was at standard demand, which was demonstrated in the responses. Many students only gave one conclusion, which was usually that increasing the amount of oxygen increased the rate of decay. Some students did not use the information in the graph to make conclusions. Many said that as the rate of decay increased more carbon dioxide was produced per hour without reference to an independent variable. A surprising number of students thought that increasing the temperature increased the amount of oxygen supplied to the leaves.

Q88.

The carbon cycle is a new topic for this specification, which was reflected in few students gaining top marks. Many responses used words from Question (b) about variation and evolution. Pollution or decay was seen frequently for D, combustion. The most common correct responses were either photosynthesis or respiration. As a process was asked for, an answer such as ‘food’ was not enough for the feeding mark.

Q89.

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It was encouraging to see many excellent answers gaining five or six marks. Failure to gain full marks was usually due to not using the technical terms photosynthesis or respiration, or giving confusing accounts of decay and fossilisation. Most students were able to gain at least one mark for this question.

Q90.

(a) (i) Almost two-thirds of students were able to identify photosynthesis as the process used to remove carbon dioxide from the air.

(ii) Fewer students were able to identify respiration as the process by which all organisms release carbon dioxide.

(b) There were many suggestions students could have made to reduce the amount of carbon dioxide in the atmosphere, but the majority used the picture in the question for ideas. Plant more trees and burn less fuels were common answers. Some listed several suggestions for burning less fuels, such as walk, use cars less and reduce industrial processes, but there was only one mark for these. Many said use renewable energy sources, but this on its own was not enough for the mark as burning biomass would release carbon dioxide. A specific example was needed, such as solar or wind power. The majority of students were able to score at least one mark for this question.

Q91.

The majority of students made a good attempt to answer this question. Many gained marks for stating the processes shown on the diagram, namely photosynthesis, respiration and combustion. A few linked the processes to an incorrect direction of carbon dioxide transfer, so negating the mark. Others demonstrated a good understanding of the carbon cycle and described the processes of decomposition and fossilisation, which did not gain credit as these processes were not shown on the diagram. Students found it a little more difficult to gain the marks for explaining the effects of the processes on the mass of carbon dioxide in the air. A comparison of the amount absorbed and released was required for one mark, and an overall conclusion that the amount in the air is increasing for the last mark. Just over a tenth of students scored five or six marks.

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