AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.9.3 COMMON ATMOSPHERIC POLLUTANTS AND THEIR SOURCES (PACK 3)

SCORE	PERCENTAGE
/131	%

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Q1.

(a) 16

1

(b) 8 e^- in 2nd shell
6 e^- in 3rd shell

allow •, x ,e^- or any combination

1

(c) oxygen ⟶ sulfur dioxide

allow = in place of ⟶
*do **not** accept sulfur oxide*
ignore symbols

1

(d) acid rain

1

(e) yes / no

any **two** from:

- increases

  allow goes up

- constant

  allow similar

- decreases

  allow goes down
  allow levels off (at the end)

2

correct date range for any one of the above

- (increases) 1984−1987
- (constant) 1987−1990
- (decreases) 1990−2014

1

(f) (69 + 6 =) 75

1

100 − 75 = 25(%)

allow a final percentage calculated from an incorrect value in the first step

1

*an answer of 25(%) scores **2** marks*

[9]

Q2.

(a) CO_2

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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
- harms / kills plants / trees
- harms living organisms in ponds / rivers / lakes
  allow harms aquatic organisms

1

[9]

Q3.

(a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

1

(b) toxic

accept causes death

1

acid rain
or
respiratory problems

accept respiratory problems / asthma

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1

global dimming

1

(c)

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 may also be a simple judgement.	3-4
Level 1: Relevant points are made. They are not logically linked.	1-2
No relevant content	0
Indicative content • methane is the best fuel because it gives more energy per gram than coal, and gives less carbon dioxide per kJ of energy produced • petrol is best because it being a liquid is easier to handle than gas or coal - although the energy content is lower than the others, it gives out less carbon dioxide than coal • methane has more energy per gram than coal • coal produces most carbon dioxide • coal can produce sulfur dioxide	

6

[10]

Q4.

(a) any **two** from:

- Earth's atmosphere more / mostly nitrogen
  allow converse
- Earth has more oxygen
  allow Venus has no oxygen
- Earth has (much) less carbon dioxide
  allow converse

2

(b) (carbon dioxide) respiration / combustion / volcanic eruptions / decomposition / animals

allow (carbon dioxide) breathed out

1

(oxygen) plants / algae / producers / photosynthesis

1

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(c) evaporation / transpiration

allow (enters atmosphere through) exhalation

1

precipitation / rain / snow / sleet / condensation / freezing

1

(d) global warming

1

(e) any **two** from:

- sea-level rise **or** high tides travel further inland
- melting ice caps
- flooding
- less land for farming
- changes to which plants will grow (due to climate change)
- (increased) coastal erosion
- extreme weather
- change in rainfall
- drought
- desertification
- loss of habitat
- temperature stress (for humans and wildlife)
- decreased food-producing capacity of some regions

ignore global warming

ignore temperature change unqualified

2

[9]

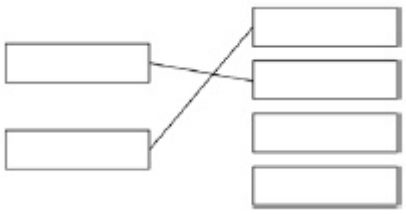
Q5.

(a) chlorophyll

ignore chloroplast

1

(b)



*do **not** accept more than one line from each method*

1

1

(c) black spot / fungus has evolved / mutated to be resistant (to the fungicide)

1

(d) (6200 – (3300 + 1750) =) 1150 (Mg)

1

(e) 1150 × 1000 = 1150000 (kg)

1

(f) power stations use less coal

1

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(g) less sulfur dioxide from all sources / total

1

(h) any **one** from:
- data only shown from 1970
- fewer power stations (therefore fewer emissions)

1

(i) less sulfur dioxide

or

less acid rain

1

(that) destroyed fungus / spores

1

[11]

Q6.

(a) 0.0025

1

(b) tobacco smoke

1

soot

1

(c) any **two** from:
- as concentration of $PM_{2.5}$ increases, so does number of deaths
- (risk of) lung cancer increases (very) rapidly initially
  or
  after a concentration of 2.5
  or
  until concentration is 14.5 / 15
- at a concentration of 12.5 the risk of death from cancer and the risk of death from lung disease are the same
- above a concentration of 12.5 risk of death from lung cancer is higher than the risk of death from other lung diseases
- above a concentration of 15 risk of death from cancer / other lung diseases increase at a slower rate

2

(d) can go deep into people's lungs

1

(e) increase in vehicles

1

increase in factory emissions

1

(f) any **one** from:
- stay indoors
- wear a face mask (when outside)

1

[9]

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Q7.

(a) Colourless liquid / condensation / water

1

(b) incomplete combustion of the fuel

1

because not enough oxygen

1

(c) Sulfur dioxide

1

[4]

Q8.

(a) $N_2 + 2O_2 \longrightarrow 2NO_2$

correct formulae for reactants

1

correct balancing

1

(b) 2.96 − 0.98

correct values read from graph

1

1.98 ÷ 2.96 (×100)

allow ecf from readings from graph

1

= 66.9(%)

*allow 66.9 shown without working for the **3** calculation marks*

1

*incorrect number of sig. figs max **2** marks*

(c) less acid rain **or** fewer respiratory problems in humans

allow improved air quality

1

[6]

Q45.

(a) number of (cress) seeds that grew

1

(b) (i) 35 (%)

1

(ii) <u>sulfur dioxide</u> reduces the growth of seeds

allow SO_2 for sulfur dioxide

accept <u>sulfur dioxide</u> reduces the germination of seeds

*do **not** allow sulfur dioxide prevents the growth of seeds*

ignore references to sodium metabisulfite (solution) or water

1

[3]

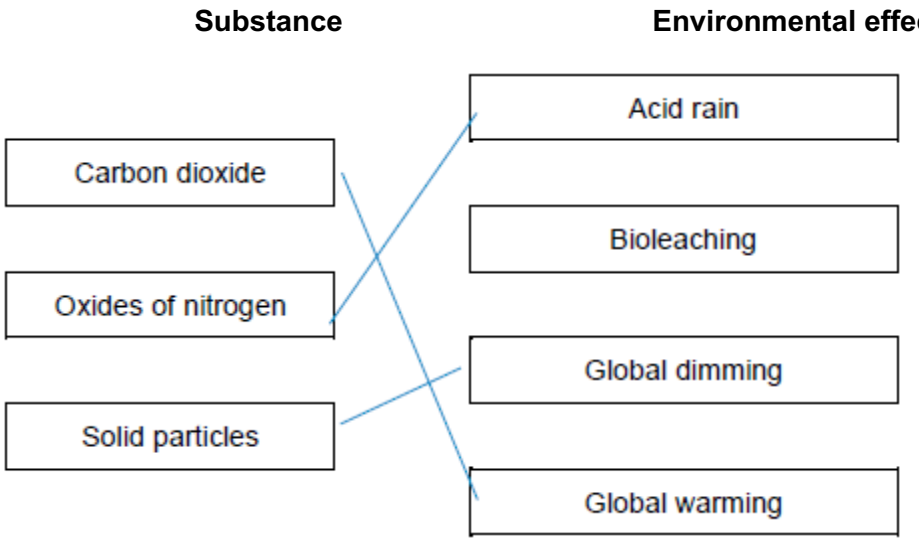
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Q46.

(a) combustion

1

(b)



extra lines from substance negates mark

3

[4]

Q47.

(i) solid particles

accept soot / carbon / unburnt fuels

1

(ii) global dimming

allow smog

1

(iii) any **two** from:

- irregular pattern in the graph
- cannot predict future development of industry / technology
- cannot predict future number of cars
- cannot predict future efficiency / type of engines
- might be other sources of particulates in future
- change in amount of fossil fuels burnt
- cannot predict future volcanic eruptions

allow change in use to other fuels / energy sources

2

[4]

Q48.

(a) carbon dioxide

1

water

each extra box ticked cancels one mark

1

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(b) sulfur dioxide

1

acid rain

1

particles

1

must be in correct order
accept phonetic spelling – see marking guidance 3.6

dimming

1

[6]

Q49.

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]

Q50.

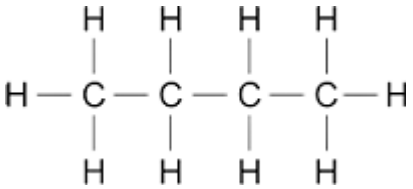
(a) C_3H_8

allow H_8C_3
C and H must be upper case 3 and 8 should be subscript
*do **not** accept superscript 3 or 8*

1

(b)

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all bonds must be shown
all letters must be upper case
ignore circles around letters
*do **not** allow double bonds*

1

(c) carbon dioxide + water

answers can be in either order
accept carbon dioxide as CO_2 and water as H_2O
numbers in formulae must be subscript

1

(d) (smoke is) carbon

ignore soot

1

(formed by) incomplete combustion

accept insufficient oxygen

1

[5]

Q51.

to obtain all four marks, at least one argument for biodiesel and one argument against biodiesel must be given
if no fuel named assume it refers to biodiesel

any **four** from:

arguments for biodiesel:

- burning biodiesel produces low amounts of particulates so less global dimming
  accept unburnt hydrocarbons / soot as alternatives to particulates
- absorbs carbon dioxide when plants are growing so carbon dioxide released when burnt equals carbon dioxide taken in
  accept carbon neutral
- removes need to dispose of cooking oil
- using a renewable resource so conserving crude oil / non-renewable resources

4

arguments against biodiesel:

- burning biodiesel produces high amounts of nitrogen oxides so more acid rain formed
- deforestation leads to a reduction in absorption of carbon dioxide so increased global warming

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- production of biodiesel leads to increased carbon dioxide output so overall is not carbon neutral
- production of fuel crops rather than food crops could lead to food shortages / food price increases

conclusion supported by the argument presented

Compensation marks

- *apply if 0 or 1 mark scored:*
- ***three / four** comparisons **from table = 2** marks*
- ***two** comparisons **from table = 1** mark*

*compensation marks added to previous marks scored but restricted to maximum of **2** marks for question total*

1

[5]

Q52.

(a) (i) water vapour

allow steam

1

condensed

allow cooled to form a liquid / water

second marking point can only be awarded if first marking point correct

1

(ii) carbon dioxide

allow CO_2

C and O must be upper case

numbers in formulae must be subscript

*do **not** accept carbon (mon)oxide / CO*

1

(iii) ammonia

1

methane

1

(b) nitrogen

1

oxygen

1

(c) (i) combustion

1

(ii) in calcium carbonate

1

in fossil fuels

1

[10]

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Q53.

(a) because the sensors are not near where people / residents live

accept because the sensors are not between cement works and where people live

1

because the sensors are not positioned where concentration of particles was likely to be highest

accept because the sensors are not positioned downwind

1

(b) the average concentration of particles was **only** 1.8(ppm)

or the average concentration of particles was below 2(ppm)

accept the average concentration of particles was 1.8(ppm) which is less than 2.0 (ppm)

1

(c) because the readings at some (2/3) sensors could have been higher than 2ppm

1

because the sensors did not detect particles below 0.5mm

1

because small particles / particles below 0.5mm / 0.4mm / 0.3mm / 0.2mm could (still) cause cancer / asthma

1

*ignore global dimming **or** cars becoming dirty **or** position of sensors*

[6]

Q54.

(a) (i) 344 – 350(°C)

1

(ii) 216(°C)

1

(iii) the vapours / gases cool as they rise up the fractionating column

1

which causes the vapours / gases to condense

1

at different temperatures or into fractions that have different boiling points

1

(b) (i) $10 \longrightarrow 6 + 8$

1

$7 \longrightarrow 6 + 8$

1

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(ii) first reaction is complete combustion

accept first reaction has excess/enough oxygen

1

second reaction is incomplete combustion

accept second reaction has limited oxygen

1

[9]

Q55.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

No relevant content.

0 marks

There is a brief description of a positive and a negative environmental impact involved with one or more methods used to reduce the amount of plastic bags sent to landfill.

Level 1 (1–2 marks)

There is some description of both positive and negative environmental impacts involved with at least 2 methods used to reduce the amount of plastic bags sent to landfill.

Level 2 (3–4 marks)

There is a clear, balanced and detailed description of both a positive and a negative environmental impact of using each of the 3 methods used to reduce the amount of plastic bags sent to landfill.

Level 3 (5–6 marks)

examples of the points made in the response

Reuse:
Reuse means less bags used so:

Positive environmental impact

- Saves raw materials/crude oil
- Saves energy
- Cuts down on CO_2 emissions
- Less global warming

Negative environmental impact

- Could cause litter
- Could still be sent to landfill

Recycle:
Bags can be recycled so:

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Positive environmental impact

- Used to make new plastic bags / objects
- Saves raw materials / crude oil
- Saves energy compared to producing plastic bags from crude oil
- Cuts down on CO_2 emissions
- Less global warming

Negative environmental impact

- Collection point sites cause an eyesore / litter problem
- Transportation to recycling plant releases carbon dioxide / causes global warming

Burn:
Bags can be burned so:

Positive environmental impact

- Could provide energy for heating buildings
- Could provide energy for generating electricity

Negative environmental impact

- Increases CO_2 emissions
- Increases global warming
- Could release toxic gases
- Does not conserve raw materials / crude oil

[6]

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Q1.

(a) 45% of students achieved this mark. Common errors included 32 (most frequently seen), but also 48 and 8.

(b) 62% of students achieved this mark. Of those who did not gain credit:

- about half gave electronic structures which showed no understanding of the maximum number of electrons in any given shell
- about half were aware that there should be no more than 8 electrons in the 2nd and 3rd shells, but gave, for example, 6 electrons in the 2nd shell and 8 in the outer shell.

(c) 59% of students achieved this mark. Some students gave '=' in place of the '⟶' in the equation, but this was allowed.

Many of the incorrect responses indicated that students were not able to recognise that an equation has reactants and products separated by an arrow, and therefore do not understand the concept of an equation. These students often simply wrote 'oxygen' or another similar single word on the answer line. Some students added further products, e.g. carbon dioxide, hydrogen or water. A few students failed to gain credit because they wrote 'sulfur oxide' as the product.

(d) 77% of responses were correct with global warming as the most popular incorrect answer.

(e) This question discriminated between students well. 61% of students achieved full marks and correctly described enough of the graph, including year ranges, to demonstrate that the mass of sulfur dioxide in the atmosphere did not decrease every year in the period shown in Figure 3. A very good proportion of students were able to correctly read from the *x*-axis to give year ranges.

Lower-attaining students were unable to give accurate year ranges, although most gained at least one mark by describing the change in mass of sulfur dioxide in one or more of the three main time periods without referring to correct year ranges.

(f) 81% of students gave a correct answer with clear working, achieving two marks.

Some students confused the percentage calculation with angle measurement on the pie chart. So although they realised that industry represented a quarter of the pie chart, they took 360°, divided by four, and gave 90(%).

Others misread the value of 6% for transport, and added 9 to 69, giving 78%, and a final answer of 22%. This achieved one mark. Some students correctly calculated 75 for one mark, but then subtracted this from 360, giving an incorrect final answer of 285(%). Others multiplied or divided the values of 6 and 69, achieving no marks.

Q2.

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

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

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(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.

Q45.

(a) The dependent variable in the investigation was the number of seeds that grew in each bag. A reference to both number, e.g. amount, and to seeds was required. Incorrect responses generally mentioned control variables or referred to the water and sodium metabisulfite solutions.

(b) (i) Only a quarter of the students correctly calculated the percentage of seeds that grew. Quite a lot came up with an answer of 20% by dividing the mean value by the sum of the number of seeds that grew.

(ii) Once again students struggled to give a conclusion. The stem of the question made clear that the investigation was to find out how sulfur dioxide gas affects the growth of cress seeds. Many students simply referred to growth with the water or growth with the sodium metabisulfite solution and did not add any value. They had to refer to sulfur dioxide in their answer. Some said that sulfur dioxide stopped the seeds growing, which was incorrect.

Q46.

(a) Almost sixty percent of students knew that fossil fuels release energy by combustion, with the most common distractor being “decomposition”.

(b) Approximately a quarter of students gained all 3 marks. The most well-known link was that carbon dioxide caused global warming, with solid particles being the cause of global dimming the least likely to be known. Many linked solid particles to bioleaching, showing a lack of knowledge of two specialist terms.

Q47.

(i) Just under a fifth of students gained the mark for giving solid particles, soot or carbon as their answer. Many just wrote particles, which was ignored.

(ii) About a quarter of the students gained this mark. The most common incorrect responses were global warming, acid rain and pollution.

(iii) Two thirds of the students gained at least 1 mark. Many students wrote something about a change in the use or availability of fossil fuels in the future. This was often mentioned with using alternative energy sources in the future, which was the same

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marking point. Quite a lot of students pointed out the irregular pattern in the graph, but references to new technologies or more efficient engines were rarely seen.

Q48.

(a) Almost all students scored at least one mark. Most students said that carbon dioxide is produced when petrol burns but hydrocarbons were often given as the incorrect second product.

(b) Few students knew that solid particles cause global dimming, but thought they caused global warming. Many thought that carbon dioxide was produced when sulfur is burned; although they did go on to gain the mark for acid rain.

Q49.

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.

Q50.

(a) This common question was poorly attempted, but it was good to see that when it was answered most students wrote the formula using capital letters and subscripts. There were only a few who wrote lower case letters or numbers that were as large as the symbol letters or superscripts. Writing an incorrect formula, such as C_3H_6 or C_3H_{6+2} were the most common errors.

(b) A well answered question with over half of students answering correctly. However, a fifth of students did not attempt it. Errors made included a double bond in the structure or no bonds being drawn between the carbon atoms. Many students just added one hydrogen atom to show methane.

(c) A poorly answered question with only three-quarters of students making an attempt. Very few students knew the products of complete combustion of a hydrocarbon. A surprising number of students included various oxides and hydroxides of butane as one of the products. Other incorrect inclusions were hydrogen, carbon, butane, butene, hydrocarbon and propane. Often when formulae were given they were written incorrectly with superscripts so could not be credited. It is advisable that students write the names of chemicals if a word equation is asked for.

(d) Another poorly answered question, with no students gaining full marks with a fifth of students not making an attempt. Few students knew that smoke contains carbon, with many thinking that smoke is carbon dioxide. Many responses just included information given in the question. A few said that smoke is produced due to incomplete combustion and mentioned the production of carbon monoxide but not carbon.

Taking questions (c) and (d) together, students do not know the products of complete and incomplete combustion of hydrocarbons.

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Q51.

The vast majority of marks awarded were for comparisons of emissions given in the table. Students rarely explained the consequences of these emissions. Many students attempted to give a conclusion but found it difficult to support, making vague comments about biodiesel being more environmentally friendly. A very small proportion of students were able to be credited with three or more marks.

Q52.

(a) (i) Many students gained a mark for saying water vapour was released from the volcanoes, with many going on to say that this condensed to form water. Many students did not realise that anything had to happen to the vapour for it to form water, or thought that water could be formed from carbon dioxide.

(ii) Three-quarters of students correctly identified the main gas in the Earth's early atmosphere as nitrogen.

(iii) Identifying methane as a gas present in Earth's early atmosphere was the most common correct answer. Almost half the students gained two marks for also knowing that ammonia was present as well.

(b) Almost all students identified oxygen as one of the main gases in the atmosphere today. Over half gained full marks for also selecting nitrogen. Just under half of all students thought that hydrogen was present in today’s atmosphere.

(c) (i) Approximately three-quarters of students correctly selected combustion as being the main process causing an increase in the amount of carbon dioxide in the atmosphere.

(ii) Just under a third of students gained full marks for identifying two ways that carbon is locked up in sedimentary rocks. Given that only two types of sedimentary rock were listed in the choices this highlights a lack of knowledge of the rock cycle from Key Stage 3. The most common correct choice by students was fossil fuels.

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