AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.10.2 LIFE CYCLE ASSESSMENT AND RECYCLING (PACK 2)

SCORE	PERCENTAGE
/137	%

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Q1.

(a) condenses

1

(b) the fractions have different boiling points

1

(c) propane

*do **not** accept propene*

1

(d) C_nH_{2n+2}

1

(e) $CH_4 + \mathbf{2}\ O_2 \longrightarrow CO_2 + \mathbf{2}\ H_2O$

allow multiples

1

(f) bromine water

1

(g) to assess the environmental impact (of the stages in the life of a product)

allow to see the effect / harm / damage on the Earth / environment / planet

ignore references to energy, pollution, carbon footprint, carbon dioxide, sustainability

1

(h) **Level 2:** Scientifically relevant features are identified; the ways in which they are similar / different is made clear and the magnitude of the similarity / difference noted.

3–4

Level 1: Relevant features are identified and differences noted.

1–2

No relevant content

0

Indicative content

- burning 10 000 bags produces 10 kg more of carbon dioxide than landfill
- putting 10 000 bags in landfill produces 0.02 kg more of solid residue than burning
- putting 10 000 bags in landfill produces 50% more sulfur dioxide than burning
- burning 10 000 bags produces 25 kg of carbon dioxide, but landfill only produces 15 kg
- putting 10 000 bags in landfill produces 0.07 kg of solid residue but burning only produces 0.05 kg
- landfill produces less carbon dioxide than burning
- landfill produces more solid residue than burning
- burning produces less sulfur dioxide than landfill

[11]

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Q2.

(a) methane

1

(b) any **two** examples from:

allow effects from the same bullet point

- rising sea levels
- melting ice
- agricultural problems
- extremes of weather
- loss of habitats

ignore global warming
ignore acid rain
ignore global dimming

*do **not** accept reference to ozone*

2

(c) $\frac{6.0}{4.1} \times 0.0235$

1

= 0.0344(kg)

allow correct rounding
allow calculator reading

if no mark awarded:
*allow **1** mark for 34.4 or 0.344*
*allow **2** marks for 34.4 g*

1

*an answer of 0.0344(kg) scores **2** marks*

(d) use less plastic
or
use recycled plastic

allow carbon capture
ignore any reference to energy / fuels

1

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

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically 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

nitrogen increased
- because volcanoes produced nitrogen

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- because (denitrifying) bacteria produced nitrogen
- because ammonia was converted to nitrogen

oxygen increased
- because algae and plants produced oxygen
- by photosynthesis

carbon dioxide decreased
- because algae and plants used carbon dioxide
- by photosynthesis
- because oceans formed and carbon dioxide dissolved in the water
- because carbon dioxide formed carbonates, which precipitate as sediments or formed sedimentary limestone rocks
- because algae / plants and animals formed fossil fuels / coal / crude oil / natural gas

[12]

Q3.

(a) let the glow spread

1

(b) 1.27 (g)

1

(c) solid

1

(d) zinc

1

(e) displacement

1

(f) A

1

(g) any **one** from:
- (good electrical) conductor
- can be bent easily

ignore malleability

- does not corrode

ignore does not rust

1

allow is ductile

(h) 2 : 3

1

(i) conserves copper ores

1

less energy used

1

[10]

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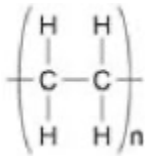
Q4.

(a) five single bonds inside the brackets (1 C−C bond and 4 C−H bonds)

1

two single bonds extending from the carbons

*allow **2** marks for an answer of:*



1

(b) HD (poly(ethene) polymer chains) have no side chains

allow LD (poly(ethene) polymer chains) have side chains
ignore cross links

1

chains are closer together in HD (poly(ethene) than LD poly(ethene))

1

(c) **Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

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

1–2

No relevant content

0

Indicative content

- suspend a poly(ethene) strip / bag
- (use a ruler) to measure length or to locate starting position
- add (known) mass / weight to the strip / bag or pull with a newtonmeter
- determine extension
- repeat using different forces (by adding further masses / weights **or** pulling harder)
- control variables: size / thickness of strip
- repeat and calculate a mean

(d) any **two** from:

- both have increasing extension with increasing force
- both extend non-linearly
- HD poly(ethene) has a smaller extension (than LD poly(ethene)) for a given force

  allow LD poly(ethene) stretches more for a given force
  allow correct readings of extension for a given force for both polymers

- HD poly(ethene) has a smaller maximum extension (than LD

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poly(ethene))

allow HD poly(ethene) breaks at a greater (maximum) force
ignore references to strong / weak

2

(e) $\frac{85}{100} \times 8.0$ (billion)

or

6.8 (billion)

allow $\frac{15}{100} \times 8.0$ *(billion)*

1

(8 billion − 6.8 billion =)
1.2 billion
or
1200 000 000
or
1.2×10^9

*allow **1** mark for an answer consistent with an incorrect conversion of billion*

1

*an answer of 1.2 billion scores **2** marks*
*an answer of 1.2 scores **1** mark*

(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 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

similarities
- both made from crude oil
- crude oil is a finite resource
- production and transport of both cause emissions of carbon dioxide
- carbon dioxide contributes to global warming
- both can be disposed of in the same ways

disadvantages of disposable bags
- each disposable bag generates more waste (than one bag for life)
- each disposable bag generates approximately 2.5 times more waste **or** 0.25 g more waste (than one bag for life)
- if 6 disposable bags used they generate approximately 15 times more waste **or** 2.35 g more waste (than one bag for life)
- if 6 disposable bags used it causes more CO_2 to be emitted (than one

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bag for life)
- if 6 disposable bags used 2.7 g more CO_2 emitted **or** approximately 1.4 times more (than one bag for life)

advantages of disposable bags
- a disposable bag causes less CO_2 to be emitted (than one bag for life)
- a disposable bag emits 5.3 g less CO_2 (than one bag for life)
- if disposable bags used more than once less CO_2 emitted (than one bag for life)
- if bag for life is used fewer than 5 times, it results in more CO_2 being emitted (than one disposable bag)
- disposable bags extend less as made from HD poly(ethene)

[18]

Q5.

(a) formulation

1

(b) 1/10

1

(c) make them palatable

1

(d) neutralisation

1

(e) carbon dioxide

1

(f) water has a boiling point of 100 °C

1

water has a melting point lower than room temperature

1

(g) $CaCl_2$

1

(h) crushed

1

melted

must be in this order

1

[10]

Q6.

(a) 2.38

*if answer incorrect, allow **1** mark for 2.37 to full calculator display*

or

for (4.82 + 2.16 + 0.15) / 3

2

(b) different types of biomass / plankton

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allow they are mixtures

1

(c) a molecule

1

(d) alkanes

1

(e) **B**

1

(f) **B**

1

(g) any **two** from:
- cracking uses a catalyst, fractional distillation doesn't
- cracking breaks up molecules, fractional distillation separates them
- cracking is a chemical process, fractional distillation is a physical process

2

(h) poly(ethene)

1

(i) (**A**=) reuse

1

(**B**=) recycle

1

[12]

Q7.

(a) 4 (C_2H_4)

1

(b) cracking involves a catalyst

1

distillation does not

or

distillation does not involve a chemical change

but cracking does

1

(c) Decomposition

1

(d) **Level 3 (5–6 marks):**
A logically structured evaluation with links involving several comparisons. Nearly all points made are relevant and correct.

Level 2 (3–4 marks):
Some valid comparisons made between the two types of bag. There may be some incorrect or irrelevant points.

Level 1 (1–2 marks):

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A vague response with few correct and relevant points and with no direct comparisons.

0 marks:
No relevant content

Indicative content

Accept converse in terms of plastic bags for all statements

- Paper bags are made from a renewable resource
- Plastic bags are made from a finite resource
- Paper bags require more energy to manufacture
- Paper bags produce more waste
- Paper bags are biodegradable
- Paper bags create more CO_2
- CO_2 created by paper bags offset by photosynthesis in growing wood
- Paper bag requires much more fresh water
- Paper bags cannot be recycled
- Agree because non-renewability less important than other factors **or** disagree because of converse **or** can't say because data inconclusive / incomplete

6

[10]

Q8.

(a) Fe_2O_3 + 3 CO → 2Fe + 3 CO_2

correct formulae of reactants

1

correct formulae of products

1

correct balancing

1

(b) iron loses oxygen – reduction

1

carbon gains oxygen – oxidation

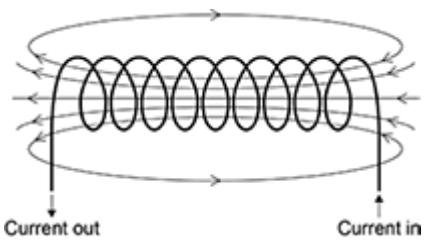
1

(c) any **four** from:

- resources for manufacture are limited
- recycling reduces the use of resources
- reduces energy consumption in extraction / manufacture
- reduces waste from processing and extraction
- reduces environmental impact of extraction

4

(d)



field lines going through and around coil

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1

correct directional arrows

1

(e) any **two** from:

1 *mark for suggestion,* ***1*** *mark for correctly linked explanation*

- use many coils **or** tight coils **or** long wire (1)
- to give a strong magnetic field for lifting heavy objects (1)

explanation must be correctly linked to the suggestion to gain the mark

or

- add an iron core
- to increase field circuit for lifting

or

- include a switch in circuit
- so can drop / pick up cars

max. 4

[15]

Q9.

(a) Carbon and hydrogen only

1

(b) Methane has the lowest boiling point and decane has the highest melting point

1

Octane is liquid over a larger temperature range than methane

1

(c) heat / steam

1

catalyst

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent evaluation is provided that considers a range of relevant points, quotes relevant data from the table and comes to a conclusion consistent with the reasoning.

Level 2 (3–4 marks):
An attempt to describe relevant points which comes to a conclusion. The logic and use
of data may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Discrete, relevant points made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.

0 marks:
No relevant content.

Indicative content

- conclusion as to which bag is more environmentally friendly

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Points that may be used in argument

- Paper bags are made from a renewable resource (wood)
- Paper bags more sustainable
- Paper bags are biodegradable
- Plastic bags are made from a finite resource (oil or gas)
- Plastic bags not sustainable
- Paper bags require more energy to manufacture (1.7 MJ compared with 1.5 MJ)
- Paper bags produce more waste (50 g compared with 14 g)
- Paper bags create less CO_2 than plastic bags
- So manufacture of plastic bags has more effect on global warming / climate change / environmental effects
- Plastic bags can be recycled
- Recycling reduces use of energy sources in manufacture
- justified

6

[11]

Q10.

(a) gravity (of moon and sun)

1

(b) any **two** from:

1 *mark for statement,* ***1*** *mark for correctly linked reason*

- tidal energy is renewable (1)
- so won't run out like fossil fuels (1)

or

- doesn't emit carbon dioxide
- so won't contribute to global warming / climate change

or

- doesn't emit oxides of sulfur or nitrogen
- so doesn't cause acid rain

or

- doesn't use fossil fuels
- so less impact on environment of extraction / transport

or

- doesn't produce particulates
- so less effect on health / environment

Max. 4

(c) coal consumption per year = 29.25 × 1000 × 6 million = 175 500 000 000 MJ

1

1 hectare of willow will produce 9 × 13 × 1000 = 117 000 MJ per year

1

so need 175 500 000 000 ÷ 117 000 = 1 500 000 (hectares)

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1

*allow 1 500 000 with no working shown for **3** marks*

(d) although has higher direct emissions than other fuels

1

it has much lower lifetime emissions

1

[10]

Q11.

Level 3 (5–6 marks):
A detailed, coherent and logical justification of the scientist's statement, with relevant links made between statements in the question, phytomining and the effects of other methods of metal production on the environment.

Level 2 (3–4 marks):
An attempt to justify the scientist's statement is made, with some attempt at linking statements. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Discrete relevant points made. The logic may be unclear and may not be consistent with the reasoning. Links are not made.

0 marks:
No relevant content

Indicative content

- phytomining conserves supplies of ores
- copper will be available for longer as at present rate of use copper ores will run out in about 35 years
- phytomining conserves supplies of fossil fuels or energy
- less fuel used at a lower cost
- mining scars landscape or produces noise pollution
- mining destroys wildlife habitats
- with more phytomining less need to mine ores
- with phytomining less habitat destroyed or less scarring of landscape
- with phytomining less need to use landfill for waste
- burning fossil fuels produces carbon dioxide / greenhouse gas
- burning fossil fuels causes global warming or climate change
- extraction from ores produces sulfur dioxide which causes acid rain

[6]

Q25.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1–2 marks)
A brief reason is given against extraction or for recycling. There is little scientific terminology used.

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Level 2 (3–4 marks)
Some reasons are given with clear statements against extraction and or for recycling. Some scientific terminology is used

Level 3 (5–6 marks)
Several reasons are given with a detailed explanation against extraction and for recycling. Scientific terminology is used accurately

examples of chemistry points made in the response

ignore uses and properties of aluminium. Comparative statements count for both methods

extraction:

- limited resources of aluminium oxide
- higher temperatures required
  allow quoted temperatures eg extracted at 950°C
- large amount of energy required
- expensive
- requires mining / quarrying
- process takes longer / has more stages
- produces more carbon dioxide / greenhouse gases

recycling:

- saves resources
- cheaper to recycle
- uses less energy
- only needs to be melted
  allow quoted temperatures eg melted / recycled at 700°C
- less electricity needs to be *used*
- less effect on environment
- example of *effect on environment*
  eg less destruction of habitats
- avoids need for disposal / use of landfill
- no need for quarrying
- sustainable

6

[6]

Q26.

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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:

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

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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.

Foundation

(a) 58% of students selected the correct response ‘condenses’. The most commonly seen incorrect answer was ‘dissolves’.

(b) 54% of students recognised that the fractions separate due to different boiling points.

(c) 15% of students gained credit, recognising the alkane to be propane. This suggests that students are not familiar with the use of models to represent alkanes.

(d) The correct answer of C_nH_{2n+2} was the most commonly chosen, by 42% of students, although C_nH_{2n} proved an effective distractor.

(e) Balancing an equation such as this combustion of methane was very demanding for the vast majority of students. 13% of students achieved this mark.

Multiples were accepted. Some students who did not gain credit had a valiant attempt at balancing, evidenced by their calculations and working alongside the question. Others had little idea, either inserting a variety of numbers and / or formulae on the answer lines, or simply not attempting it.

(f) The correct answer of bromine water was the most commonly chosen, by 44% of students, although limewater proved an effective distractor.

(g) 8% of students knew the definition from the specification, or were able to give an equivalent statement. A large number of vague responses were seen such as ‘to see how we can do things better’.

(h) The least creditworthy responses discussed in general terms the effect on the environment of burning waste plastic and using landfill. Students writing these responses made little reference to the information in the table, and many of these students missed the key command word, ‘Compare’.

13% of students achieved marks in level 1 by giving some comparisons of the gases and residue either in qualitative terms or by quoting values from the table. To access level 2, students were expected to ‘note the magnitude’ of the differences, as stated in the generic level descriptor in the mark scheme. 30% of students were awarded a level 2 mark.

Some students had difficulty interpreting the information in the table, reversing the causal relationship, and attempted to suggest that the emissions caused the disposal method. A number of students were unable to express the comparisons clearly or accurately, for example suggesting that the processes used carbon dioxide or sulfur dioxide, or writing that landfill increases the sulfur dioxide by 10%. Some students’ calculations from the table were incorrect, for example the difference the mass of sulfur dioxide produced by the two methods was sometimes given as ‘10’, and the difference between the mass of solid residue given as ‘20’.

Students did demonstrate a good understanding of environmental responsibility.

Higher

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(a) 83% of students achieved this mark. None of the other three possible answers proved to be dominant.

(b) 79% of students achieved this mark. 'The fractions have different melting points' proved to be dominant wrong answer.

(c) 49% of students gained credit, recognising the alkane to be propane. Most popular incorrect answer was butane. Some students gave a formula even though the question asked for the name of the alkane.

(d) The correct answer of C_nH_{2n+2} was the most commonly selected response by students (77%) although C_nH_{2n} proved to be the most effective distractor.

(e) 56% of students successfully balanced equation for the combustion of methane. Multiples were regularly seen, and credit accordingly given.

(f) The correct answer of bromine water was chosen by 67% of students. Anhydrous copper sulfate proved to be the most effective distractor.

(g) 28% of students knew the definition from the specification or were able to give an equivalent statement. A large number of vague incorrect responses were seen encompassing issues such as pollution, sustainability, energy and carbon footprint.

(h) In this 'extended response' question students were asked to compare the two methods for the disposal of biodegradable plastic bags using information given in the table.

26% of students gained full marks on this question and a further 38% of students achieved marks at level 2. To access level 2, students were expected to 'note the magnitude' of the differences, as stated in the generic level descriptor in the mark scheme.

17% of students achieved marks in level 1 by giving some comparisons of the gases and residue either in qualitative terms or by quoting values from the table.

The least creditworthy responses discussed in general terms the effect on the environment of burning waste plastic or the benefits of burning plastic bags to generate electricity. Students writing these responses made little reference to the information in the table and many of these students ignored the key command word, 'Compare'. However, the higher-attaining students had logically worked their way down the information in the table, comparing and calculating differences when constructing their answer.

Q2.

Foundation

(a) 63% of students recognised methane as a greenhouse gas. Nitrogen was the most commonly seen incorrect response.

(b) This question discriminated well. 29% of students were able to name two effects of climate change, with the next 33% naming one effect.

Students who did not gain credit were sometimes too vague, for example giving responses such as unspecified changes in the weather, or unspecified effects on people. Others gave causes rather than effects of climate change, or referred to acid rain, pollution or ozone.

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(c) Many students found this calculation challenging with 3% of students able to give the correct answer. 70% of students managed a single division or multiplication with two of the numbers given, but were unable to continue to complete the calculation required. Some of those who knew the correct method failed to convert from grams to kilograms, but were still able to access one of the two marks. Some students were able to apply the correct method, but did the calculation in two parts, and their rounding after the first part gave rise to an incorrect final answer. Students should be aware that they should not do any rounding until they reach their final answer.

(d) 13% of students suggested using less plastic or recycled plastic, or gave a reference to carbon capture. Some incorrect responses focussed on the disposal, including burning, rather than the manufacture of plastic. Planting trees to capture the carbon proved a popular idea.

(e) This 'extended response' question discriminated well. It asked for an explanation of how the levels of three gases have changed since the Earth's early atmosphere. To achieve marks in level 1, statements of change for the three main gases in the Earth's atmosphere was required. When explanations were linked to the changes, marks in levels 2 or 3 were awarded. The clearer, more logical and more detailed accounts achieved level 3 marks.

4% of students achieved a level 3 mark on this standard demand question. Some accurate and well expressed responses were seen, succinctly explaining the changes to all three gases. The most logically sequenced of these discussed each of the three gases in turn, resulting in very readable and accessible accounts. A further 12% of students achieved a level 2 mark, and a further 32% achieved a level 1 mark.

Many of the lower-attaining students discussed modern day changes to the Earth's atmosphere, rather than addressing the changes since the Earth's early atmosphere. These students attempted to explain increases in carbon dioxide levels due to industrial or other human activity, and decreases in oxygen due to increasing population. Some students included mention of the ozone layer. Some of these accounts were less logically sequenced and suggest that lower-attaining students are more challenged by the concept of evolutionary timescales, or are failing to read the question carefully.

As mentioned in the general comments for this paper, students should note the command word for an extended response question carefully. In this question students were asked to 'Explain'. Many students qualitatively described the changes in amounts of nitrogen, oxygen or carbon dioxide since the Earth's early atmosphere, but were not successful at linking these changes to explanations. When students did attempt an explanation, the effects of photosynthesis on changes in the percentages of oxygen and carbon dioxide were better known than those of volcanic action on the change in percentage of nitrogen.

Higher

(a) Methane was recognised by 85% of students as a greenhouse gas. Nitrogen was the most commonly seen incorrect response.

(b) 60% of students were able to name two effects of climate change, with a further 29% of students able to name one effect. Students give a wide range of creditworthy responses; melting polar ice caps, named extremes of weather and / or desertification.

Students who did not gain credit were sometimes too vague, for example giving

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responses such as unspecified changes in the weather, or unspecified effects on people. Others gave causes rather than effects of climate change or referred to acid rain.

(c) 51% of students achieved some credit on this question. Many of those who knew the correct method failed to convert from grams to kilograms and consequently achieved only one mark for the calculation. The remainder of students attempted a single division or multiplication with two of the numbers given but were unable to continue to complete the calculation required.

Some students were able to apply the correct method, but did the calculation in two parts, and their rounding after the initial calculation gave rise to an incorrect final answer. Students should be aware that they should not undertake any rounding until they reach their final answer.

(d) 27% of students suggested using less plastic or recycled plastic in the manufacture of plastic bottles or gave a reference to carbon capture. Some incorrect responses focussed on the disposal, including burning plastic, rather than the manufacture of plastic or transportation of the plastic bottles, releasing carbon dioxide in to the air. Planting trees to capture the carbon or using renewable energy sources to provide energy for manufacturing the bottles proved popular ideas.

(e) This 'extended response' question discriminated well. It asked for an explanation of how the levels of three gases have changed since the Earth's early atmosphere. To achieve marks in level 1, statements of change for the three main gases in the Earth's atmosphere was required. When explanations were linked to the changes, marks in levels 2 or 3 were awarded. The clearer, more logical and more detailed accounts achieved level 3 marks.

19% of students achieved a level 3 mark on this standard demand question. Some accurate and well-expressed responses were seen, succinctly explaining the changes to all three gases. Many students gave detailed responses that showed a greater depth and understanding, giving numerous linked explanations for the changes in composition of the gases in the Earth's atmosphere. The most logically sequenced of these discussed each of the three gases in turn, resulting in very readable and accessible accounts. 33% of students achieved a level 2 mark, and a further 27% achieved a level 1 mark.

However, many of the lower-attaining students discussed post Industrial Revolution changes to the Earth's atmosphere, rather than addressing the changes since the formation of the Earth's early atmosphere. These students attempted to explain increases in carbon dioxide levels due to industrial manufacturing or other human activity; decreases in oxygen due to increasing population or deforestation. Some of these accounts were less logically sequenced and suggest that lower-attaining students are challenged by the concept of evolutionary timescales or are failing to read the question carefully.

As mentioned in the general comments for this paper, students should note the command word for an extended response question carefully. In this question students were asked to 'Explain'. Many students qualitatively described the changes in amounts of nitrogen, oxygen or carbon dioxide since the formation of the Earth's early atmosphere but were not successful at linking these changes to explanations. The most popular explanation was the effects of photosynthesis on changes in the percentages of both oxygen and carbon dioxide. The dissolving of carbon dioxide into the newly formed oceans was better known than those of the volcanic action on the change in percentage of nitrogen.

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Q3.

(a) Students found this difficult with more students giving the distractor of the mixture being heated to show that the reaction was exothermic than the correct response.

(b) 33% of students were able to correctly use the law of conservation of mass to calculate the answer. Incorrect responses gave a variety of methods of using the three numbers given in the question.

(c) Students found using the state symbols in the equation to determine the physical state of zinc oxide difficult, with gas being the most common response.

(d) 45% of students were able to identify zinc as the substance which had been oxidised.

(e) More students answered in terms of the reaction between zinc and copper oxide being an example of combustion rather than displacement.

(f) 44% of students were able to identify the structure of atoms in pure copper.

(g) Most correct responses were in terms of electrical conduction, with a few continuing to give a detailed description of how the metal conducted electricity which was not required at this level. 57% of students achieved this mark. A few answered in terms of flexibility. Some didn't realise that the question related to electrical wiring and gave responses in terms of thermal conductivity.

(h) 67% of students were able to identify the simplest ratio from the data used in the question.

(i) 52% of students were able to identify both of the correct advantages of recycling copper, with nearly all obtaining at least one mark. Conserves copper ores was more commonly known than less energy used.

Q4.

Foundation

(a) Around one quarter of students did not attempt this question.

Of those who did, very few, around 1%, were able to draw the correct diagram. Some scored 1 mark, usually for the five single bonds within the bracket.

The most common incorrect diagram was just a repeat of the structure of ethene which had been given in the question. The significance of the 'n' was not understood by some students − some answers showed a pattern of 'n's around the outside of the bracket.

(b) Around 8% of students gained both marks. Many students, around 50%, gained one mark, usually for pointing out that the LD poly(ethene) has side chains, whereas HD does not.

Despite the fact that both the polymer chains and the side chains were labelled, many students chose to ignore these terms to talk about 'wiggly lines' and 'a cracked appearance'.

(c) More than 40% of students did not attempt this question.

Of those who did attempt it, some did not describe a method, merely stating that

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poly(ethene) extends when a force is applied.

Of those who attempted to describe a method, many failed to score more than two of the four marks available because their account lacked detail and would not lead to a valid outcome. In many cases, this was because ‘see how much it stretches’ was stated with no detail as to how this would be done. In other cases, there was no indication that more than one force would be applied to the poly(ethene).

There were quite a few references to pulling the polythene and examining it under a microscope. A small number of students described the extension of a spring experiment, with no mention of poly(ethene) at all.

(d) Around 10% of students gained one mark for this question, with a very small number gaining both marks. The answers tended to be very imprecise, such as ‘HD needs a greater force than LD’ and ‘LD has a greater extension than HD’.

Many students stated that one extended faster than the other; as no time values were given, this is incorrect.

(e) Around 18% of students scored two marks for this question, with a further 20% gaining one mark. Some worked out 85% of 8 billion, and quoted this as their answer, failing to subtract this from the original 8 billion.

A commonly seen error was dividing by 0.85 instead of multiplying.

Another common error was to put an incorrect number of zeros for billion (instead of just leaving it as ‘billion’). Another common error was an inability to perform the percentage calculation correctly. To work out 85% of 8 billion, many students worked out 10% of 8 billion, and then 1%, then added 8 lots of 10% to five lots of 1%. Coupled with a large number of zeros, this method had the potential for errors to arise.

(f) More than 20% of students did not answer this, the last question on the paper. Most students who wrote something made a good attempt at this 'evaluation' question based on LCAs. Many students were able to point out that bags for life were better from the point of view of 'waste'. A simple comparison for CO_2 emissions on a 'per bag' basis was also given by many. Few students processed the data for CO_2 emissions to show that on a 'per use' basis, bags for life were more environmentally desirable. Some students misinterpreted the word 'emitted' and referred to the use of CO_2 during the production and transport of the bags. Few students did calculations when comparing the data.

A Level 2 answer (three or four marks) involved comparing the two types of carrier bag qualitatively, e.g. ‘more waste is generated from the production of one disposable bag compared with a bag for life’ and addressing both waste and carbon dioxide. Around 40 % of students fell into this category.

A few students (around 4%) achieved Level 3 (five or six marks) for going a step further and involving calculations such as ‘around two and a half times as much waste is generated from the production of one disposable bag compared with a bag for life’. In addition, both waste and carbon dioxide had to be addressed quantitatively. Also, a judgement needed to be made, either saying which type of bag was better, with reasons why, or giving the pros and cons of both types of bag.

Students whose answers were Level 1 standard (one or two marks) tended to discuss only one aspect of the information given, or to ignore the information altogether and write something from their own knowledge. Answers which merely stated the given information without any comparisons did not gain credit.

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Higher

(a) Around 7% of students did not attempt this question. Very few students were able to draw the correct diagram. Some scored one mark, either for the five single bonds within the bracket or for the two single bonds extending outwards from the two carbons.

The most common incorrect diagram was just a repeat of the structure of ethene which had been given in the question. Another incorrect answer was to ignore the monomer diagram and to draw out a structure, usually of an alkane, or an alkane-type structure but with carbon-carbon double bonds.

(b) Most students attempted this question, with around one quarter gaining both marks. A further 50% gained one mark, usually for pointing out that the LD poly(ethene) had side chains, whereas HD did not. A number of students also picked up on the difference between the polymer chains but commented about the difference in number rather than their proximity.

Despite the fact that both the polymer chains and the side chains were labelled, a minority of students chose to ignore these terms to talk about 'wiggly lines' and 'cracks'.

(c) The question asked was to describe a method to investigate how the extension of poly(ethene) changes with the force applied. A number of students did not take on board that the command word was 'describe' but attempted to explain (a different command word) why poly(ethene) extends.

Many students who did describe a method failed to score more than two of the four marks available because their account lacked detail and would not lead to a valid outcome. In many cases, this was because 'measure the extension' was stated with no detail as to how this would be done. In other cases, there was no indication that more than one force would be applied to the poly(ethene).

A small number of students described the extension of a spring experiment, with no mention of poly(ethene) at all.

(d) Fewer than 2% of students scored both marks, although a further quarter gained one of the marks, often for stating that for both types of poly(ethene) the extension increases as the force increases.

Other answers tended to be too vague, such as 'LD's extension is greater than HD'. Answers which gained credit qualified such an answer with '…for a given force' or quoted a value for force and compared the values of the two extensions.

Some students stated that one extended faster than the other; as no time values were given, this is incorrect.

(e) Around half of students scored two marks for this. Of those who did not gain both marks, some worked out 85% of 8 billion, and quoted this as their answer, failing to subtract it from the original 8 billion.

Another common error was to put an incorrect number of zeros for billion (instead of just leaving it as 'billion').

Some students made mathematical mistakes in performing the percentage calculation. To work out 85% of 8 billion, many students worked out 10% of 8 billion, and then 1%, then added 8 lots of 10% to five lots of 1%. Coupled with a large number of zeros, this method had the potential for errors to arise.

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(f) Many students made a good attempt at this 'evaluation' question based on LCAs.

A Level 2 answer (three or four marks) involved comparing the two types of carrier bag qualitatively, e.g. ‘more waste is generated from the production of one disposable bag compared with a bag for life’ and addressing both waste and carbon dioxide. Around 60% of students fell into this category.

Some students (around 14 %) achieved Level 3 (five or six marks) for going a step further and involving calculations such as ‘around two and a half times as much waste is generated from the production of one disposable bag compared with a bag for life’. In addition both waste and carbon dioxide had to be addressed quantitatively. Also, a judgement needed to be made, either saying which type of bag was better, with reasons why, or giving the pros and cons of both types of bag.

Students whose answers were Level 1 standard (one or two marks) tended to discuss only one aspect of the information given, or to ignore the information altogether and write something from their own knowledge.

Q25.

In this question students were assessed on both their scientific knowledge and ‘QWC’ - their ability to use good English, organise information and use appropriate specialist terms. In most cases the level of QWC matched their level of scientific knowledge.

Students were asked to suggest why most aluminium is recycled. They were expected to use information given in the question, as well as their own knowledge. Many students referred to the uses or properties of aluminium, rather than explaining why most aluminium is recycled. The most common science points made related to costs or the amount of energy required. To gain full marks both the advantages of recycling and disadvantages of extraction had to be mentioned.

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