OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) Combined Science B (Twenty First Century Science)

F

J260/02 Chemistry (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2.4

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet

You may use:
- a scientific or graphical calculator

First name									
Last name									
Centre number						Candidate number				

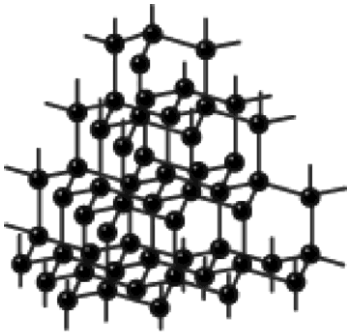
INSTRUCTIONS
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in the question marked with an asterisk (*).
- This document consists of **24** pages.

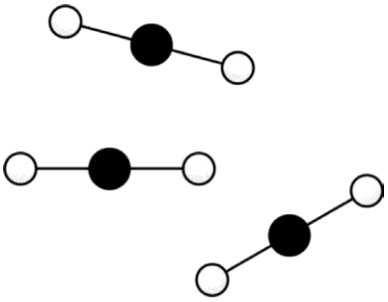
Answer **all** the questions.

1 Different types of substances have different structures.

(a)



Diamond



Carbon dioxide

Compare the structures of diamond and carbon dioxide.

Give **one** similarity and **one** difference.

Similarity .....

.....

Difference .....

..... **[2]**

(b) Diamond and graphite both contain atoms of the same element.

What is the name of the element?

Put a (ring) around the correct answer.

calcium **carbon** **iron** **nitrogen** **sulfur** **[1]**

(i) Graphite and diamond have different properties.

Put ticks (✓) in the boxes to show which properties are **true for graphite** or **true for diamond** or **true for both.**

Property	True for diamond	True for graphite	True for both
Very hard, so used as a cutting tool			
High melting point			
Conducts electricity			
Used as a lubricant			

[4]

2 A mine in Canada mines a lead ore called galena. Galena has the chemical formula of PbS.

The first stage of the process involves concentrating the galena using froth flotation.

(a) The next process is smelting. This is a two stage process.

First, the concentrated galena is reacted with air at high temperatures to form lead(II) oxide.

The word equation for this reaction is:

lead sulfide + oxygen → lead(II) oxide + sulfur dioxide

Complete the balanced symbol equation for this reaction.

$2PbS + ...O_2 \rightarrow 2PbO + ...SO_2$ **[1]**

(b) Lead metal is extracted from the lead oxide by heating it with carbon.

$2PbO + C \rightarrow 2Pb + CO_2$

(i) The carbon has been oxidised.

What has happened to the lead in this reaction?

..... **[1]**

(ii) Calculate the percentage of lead by mass in lead(II) oxide, PbO.

Give your answer to **3** significant figures.

Percentage = ……% **[4]**

(iii) 1 kg of galena yields 0.93 kg of lead(II) oxide.

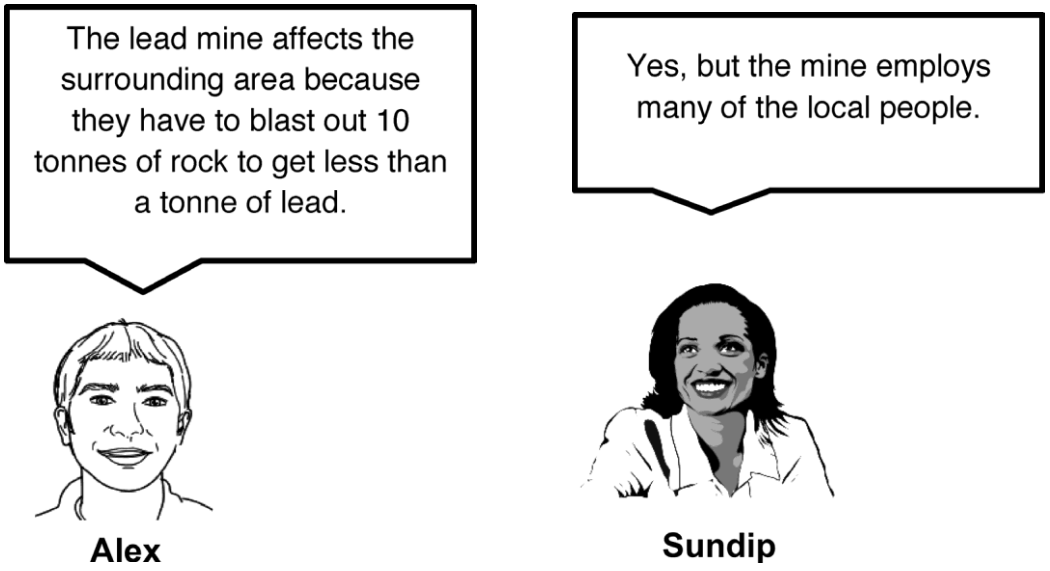
What is the maximum mass of lead in grams that can be extracted from 0.93 kg of lead(II) oxide?

Use your answer to part **(iii)** and give your answer to the nearest gram.

Maximum mass = ……g **[3]**

(c) Sundip and Alex live near a lead mine that produces millions of tonnes of lead ore.

They are talking about the advantages and disadvantages of living so near the mine.



(i) Sundip has just bought a new house in the area.

Give one **advantage** and one **disadvantage** of living near the lead mine.

.....

.....

..... **[2]**

(ii) Sundip and Alex talk about the processing of the lead at the mine.

Alex

Suggest reasons that Sundip could give for **not** closing the mine.

.....

.....

..... **[2]**

3 Sodium is an element in Group 1 of the Periodic Table.

Chlorine is in Group 7 of the Periodic Table.

(a) Chlorine has two main isotopes:

- chlorine-35 with an atomic mass of 35
- chlorine-37 with an atomic mass of 37.

The percentage abundance of these isotopes is shown in the table.

Isotope	Percentage abundance (%)
Chlorine-35	75.8
Chlorine-37	24.2

Show that the relative atomic mass of chlorine is 35.5 to **1** decimal place.

[2]

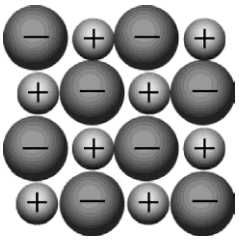
(b) **(i)** Sodium reacts with chlorine gas to form sodium chloride.

Complete the word and symbol equations for the reaction.

..... + ... → .....

.....Na(s) + Cl_2(.....) → .....NaCl(.....) **[3]**

(ii) Sodium chloride has a giant ionic structure.

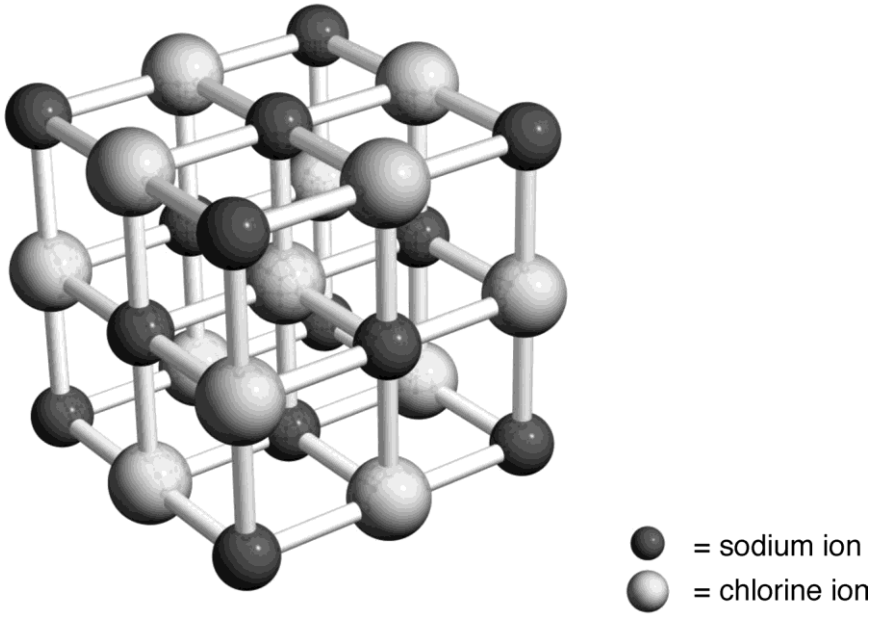


How can you tell this from the diagram?

.....

..... **[2]**

(iii) Here is a diagram of a sodium chloride crystal.



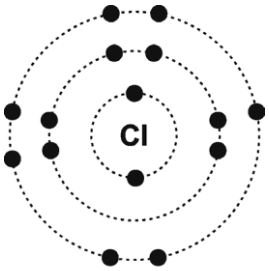
The C*l*–Na–C*l* length of a crystal of sodium chloride is 0.564nm.

Calculate the volume of the cube above in nm^3.

Give your answer to **3** significant figures.

Volume = …….nm^3 **[3]**

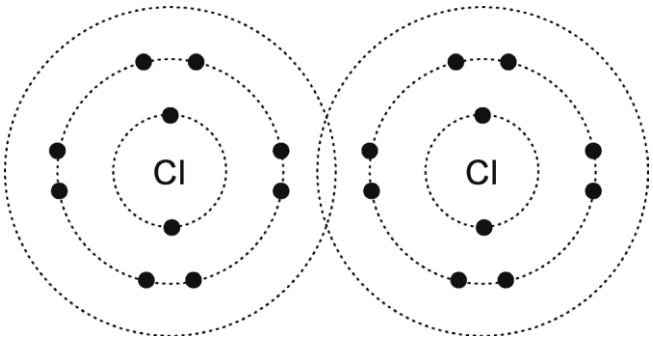
(iv) The diagram shows the arrangement of electrons in a chlorine atom.



Chlorine atom

A chlorine molecule contains two atoms held together by a single covalent bond.

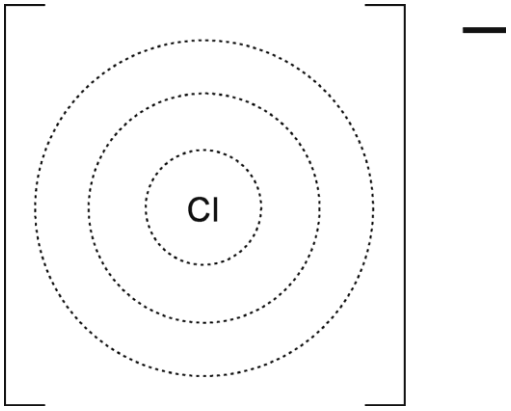
Complete the diagram to show the arrangement of electrons in a chlorine molecule.



[2]

(v) During the reaction with sodium, each chlorine atom gains an electron to form a chloride ion, Cl^-.

Complete the diagram to show the arrangement of electrons in a chloride ion.



[2]

(c) The table shows some information about chlorine and sodium chloride.

Substance	Structure	Melting point (in ºC)
chlorine	simple covalent	–101
sodium chloride	giant ionic	810

Why are the melting points of chlorine and sodium chloride different?

Put ticks (✓) in the boxes next to the **two** correct answers.

Giant ionic substances have higher melting points than simple covalent substances. ☐

Ions are strongly attracted to each other. ☐

Ionic substances dissolve easily. ☐

There are strong bonds between simple covalent molecules. ☐ **[2]**

4 Amir is investigating the reaction of magnesium ribbon with hydrochloric acid.

When magnesium and hydrochloric acid react, a gas is formed.

The equation for this reaction is as below.

magnesium + hydrochloric acid → magnesium chloride + hydrogen

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

(a) Amir wants to investigate the effect of concentration of the acid on this reaction.

He uses the following equipment:

- Conical flask
- Cotton wool
- Balance
- Stop watch
- Hydrochloric acid of different concentrations
- Magnesium ribbon
- Measuring cylinder.

Describe how Amir would do this investigation.

You may include a diagram in your answer.

.....

.....

.....

.....

.....

..... **[4]**

(b) Amir does another experiment.

- He keeps the concentration of the acid the same.
- He then investigates the rate of reaction of magnesium ribbon and magnesium powder.
- He measures the time until all the magnesium is used up.

He does his experiment three times.

	Tests			
	1	**2**	**3**	**Mean**
Reaction time using magnesium ribbon (in seconds)	78	79	80	79
Reaction time using magnesium powder (in seconds)	49	51	52	

(i) Complete Amir's results table by calculating the mean value for his experiment using magnesium powder.

Give your answer to the nearest second.

Mean = ……s **[2]**

(ii) Magnesium powder reacts more quickly than magnesium ribbon.

Explain why.

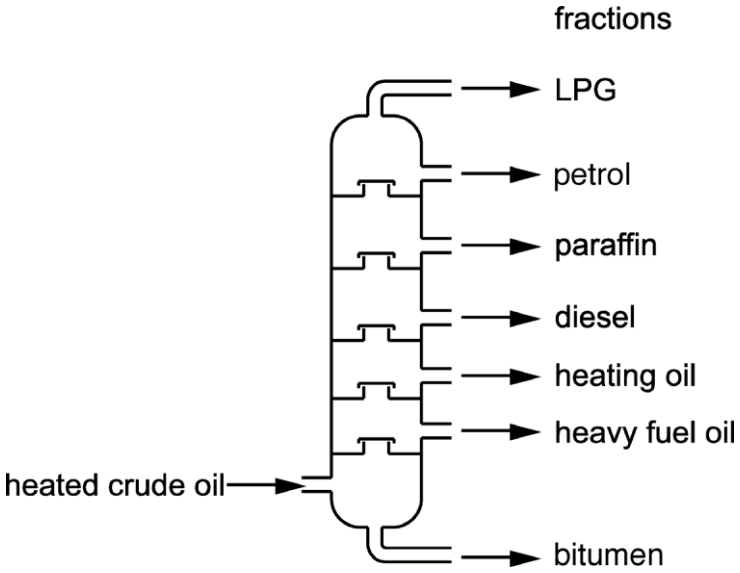
.....

.....

..... **[3]**

5 Crude oil is used as a source of fuels. It is separated into many fractions by fractional distillation.

The diagram below shows a fractionating column.



(a) Crude oil contains a mixture of hydrocarbons that boil at different temperatures.

Describe **how** crude oil can be separated using a fractionating column.

.....

.....

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.....

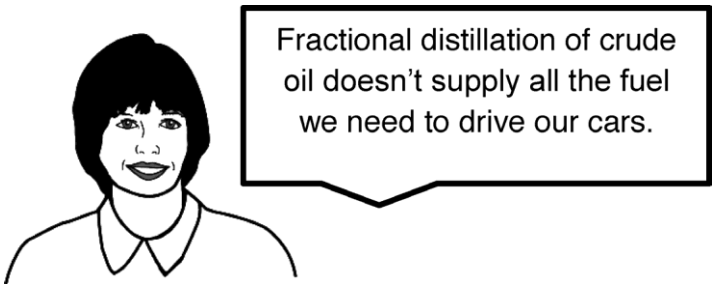
.....

..... **[4]**

(b) The table shows the percentage of each fraction in crude oil.

fraction	% in crude oil	% needed
LPG	4	4
petrol	5	22
heating oil	9	5
diesel	19	23
paraffin	13	8
fuel oil and bitumen	50	38

Jane is concerned about the supply of fuel for her car.



Use information from the table to show that Jane's concern could be right.

.....

.....

..... **[2]**

(c) What process could an oil refinery use to solve this problem?

Put a (ring) around the correct answer.

cracking **crystallisation** **evaporation** **filtration** **[1]**

(d) Scientists are looking for alternative energy sources to crude oil.

Explain why this is a good idea. Consider the uses of crude oil in your answer.

.....

.....

.....

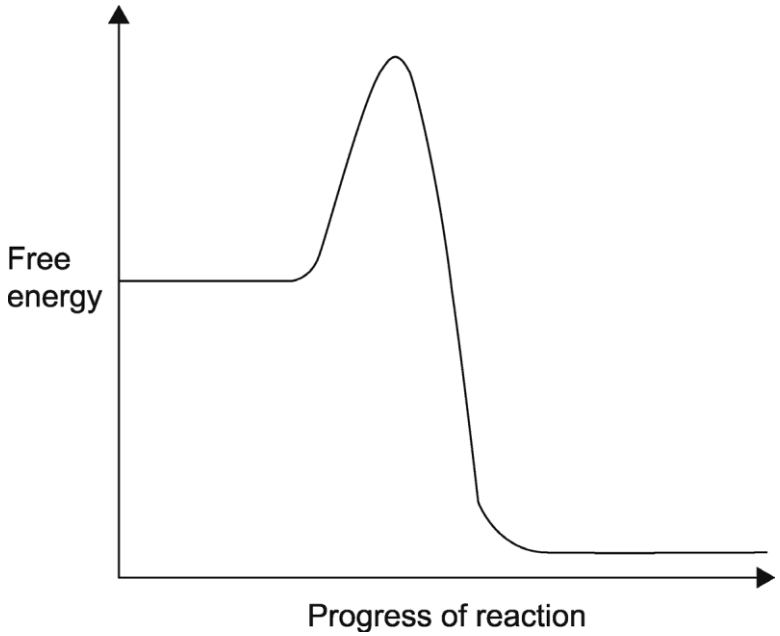
..... **[3]**

6 Self-heating food packs are available on the internet. They warm food using a chemical reaction.

The packs often use the reaction between calcium oxide and water shown below.

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s)$$

(a) Label the reaction profile for this reaction. Identify the activation energy.



[2]

(b) Complete the sentences to describe what happens in this reaction.

Use words or phrases from the list.

endothermic

exothermic

transferred from

less

transferred to

more

The products have…….energy than the reactants.

During the reaction, energy is ……. the surroundings.

The reaction is …… **[3]**

7 Sarah is a chemistry technician in a secondary school.

She has found four bottles of hydrochloric acid where the labels have fallen off.

She decides to do a titration of the contents against sodium hydroxide to find the concentration of the acid in each bottle.

The balanced symbol equation for this reaction is:

$NaOH + HCl \rightarrow NaCl + H_2O$

Here are Sarah's results.

	Volume of Hydrochloric acid (cm^3)			
	Bottle			
Test	**A**	**B**	**C**	**D**
1	28	31	52	26
2	25	30	50	24
3	25	30	50	24

Sarah did the titrations three times. She uses 25 cm^3 of the sodium hydroxide each time.

For her first test, Sarah uses a measuring cylinder to measure the sodium hydroxide and universal indicator to find the end point.

She decides her results are not accurate. For the following tests she modifies her apparatus.

(a) Suggest how Sarah could have modified her apparatus.

.....

.....

..... **[2]**

(b) The students make a dry crystalline sample of the calcium chloride from calcium carbonate and some of the hydrochloric acid.

The procedures they use are listed below.

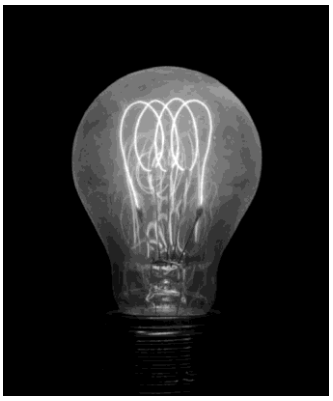
They are **not** in the correct order.

A crystallisation
B drying
C evaporation
D filtration

Put the procedures in the correct order.

[2]

8 Early light bulbs used carbon paper filaments. When electricity is passed through the bulb, the carbon paper filaments become very hot. The energy from the electricity transfers to heat and light in the bulb.



(a) The first bulbs invented by Sir Joseph Swan used carbon paper filaments in air.

These worked well but burned up quickly.

Which gas did the carbon filament react with?

Put a tick (✓) in the box next to the correct gas.

Carbon dioxide ☐

Nitrogen ☐

Oxygen ☐

Water vapour ☐ **[1]**

(b) In 1879, Thomas Edison discovered that using a carbon filament in a glass bulb filled with argon improved the design of the original bulbs. He found that this bulb lasted 40 hours.

Complete the sentences to explain how using a glass bulb filled with argon solved the problem Joseph Swan had with his light bulb.

Use the words or phrases from the list.

does not react

Group 0

Group 1

Group 7

reactive

reacts

unreactive

Argon is in ……. of the Periodic Table.

Argon is very …….

Therefore, the argon ……. with the carbon in the filament. **[3]**

9 Scientists are assessing the environmental impact of different types of shopping bags.

They carry out Life Cycle Assessments (LCA) for three different types of bags.

Their results are recorded in the table.

	Totals for 1000 bags for the whole LCA		
	paper (30% recycled fibre)	biodegradable plastic	polythene
Energy use (MJ)	2620	2070	763
Fossil fuel use (kg)	23.2	41.5	14.9
Municipal solid waste (kg)	33.9	19.2	7.0
Greenhouse gas emissions (kg CO_2)	80	180	40
Fresh water use (litres)	4520	4580	260

(a) Polythene uses the least fossil fuel of the three shopping bags.

Give **two** other reasons why, from the data above, polythene could be the best material to use for shopping bags.

1 .....

.....

2 .....

..... **[2]**

(b) A high street shop is thinking about using paper bags for environmental reasons.

From the table, calculate, as a percentage, how much more fossil fuel is used in the LCA of a paper bag compared with a bag made of polythene.

Give your answer to **1** decimal place.

Percentage = ……**%** **[4]**

(c) Although the LCA does **not** favour paper bags, the shop still decides to use paper bags.

Suggest an environmental reason, other than the information in the Life Cycle Assessment, that might have influenced the shop's decision.

.....

..... **[1]**

10 **(a)** The atomic model has changed over time.

Draw lines to join each **scientist** to their **model**.

Scientist	Model
Bohr	Plum pudding model
Dalton	Solid sphere
Thomson	Electrons in shells

[2]

(b) We now know that all atoms contain protons, neutrons and electrons.

(i) Complete the table to show the relative charges on protons, neutrons and electrons.

	Relative charge
Proton	
Neutron	
Electron	

[2]

(ii) Mendeleev organised elements into the first Periodic Table. He left gaps in the table.

Describe the basis of the arrangement of elements in Mendeleev's Periodic Table.

.....

.....

..... **[2]**

(iii) Why was Mendeleev's decision to leave gaps correct?

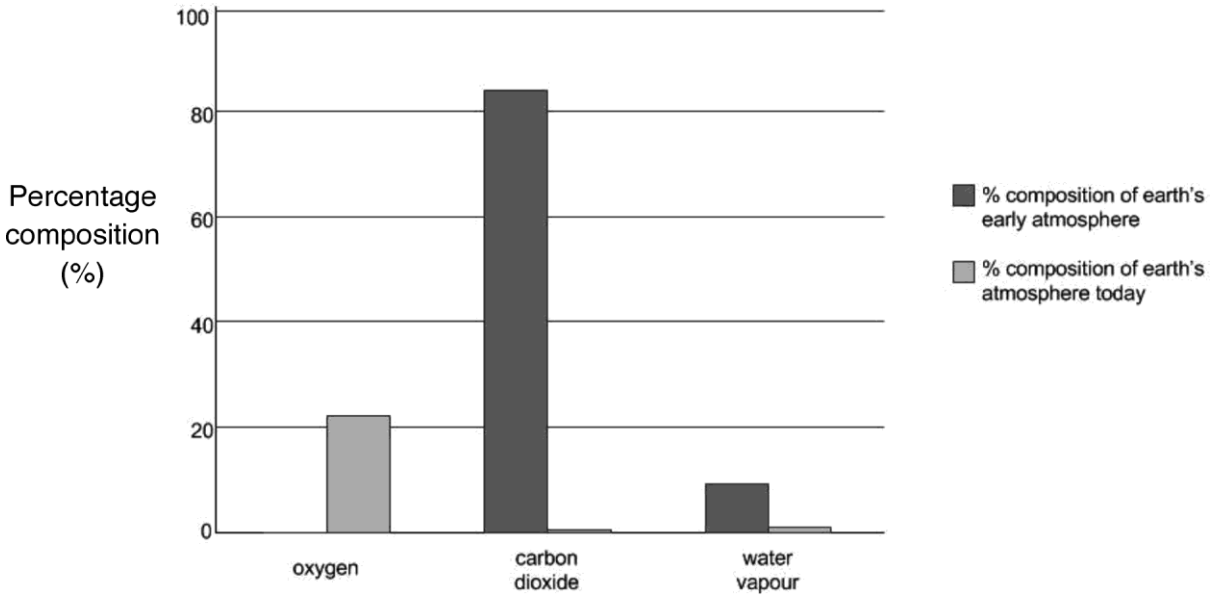
.....

.....

..... **[2]**

11 Scientists think that the composition of the early atmosphere changed slowly over many billions of years.

Scientists estimated the composition of the early atmosphere on Earth. The graph shows the percentage of gases in the early atmosphere and the atmosphere today.



Gases in Earth's atmosphere

(a) * Describe **how** and **why** the levels of these gases have changed between these two periods, leading to the formation of the oxygen-rich atmosphere we have today.

.....

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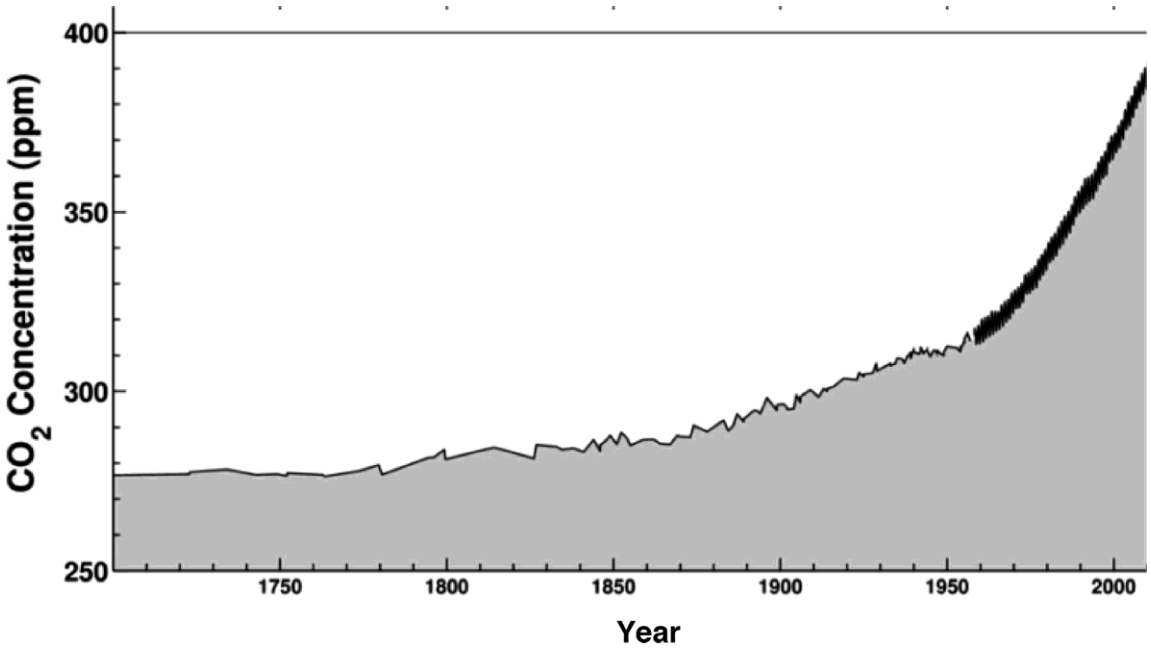
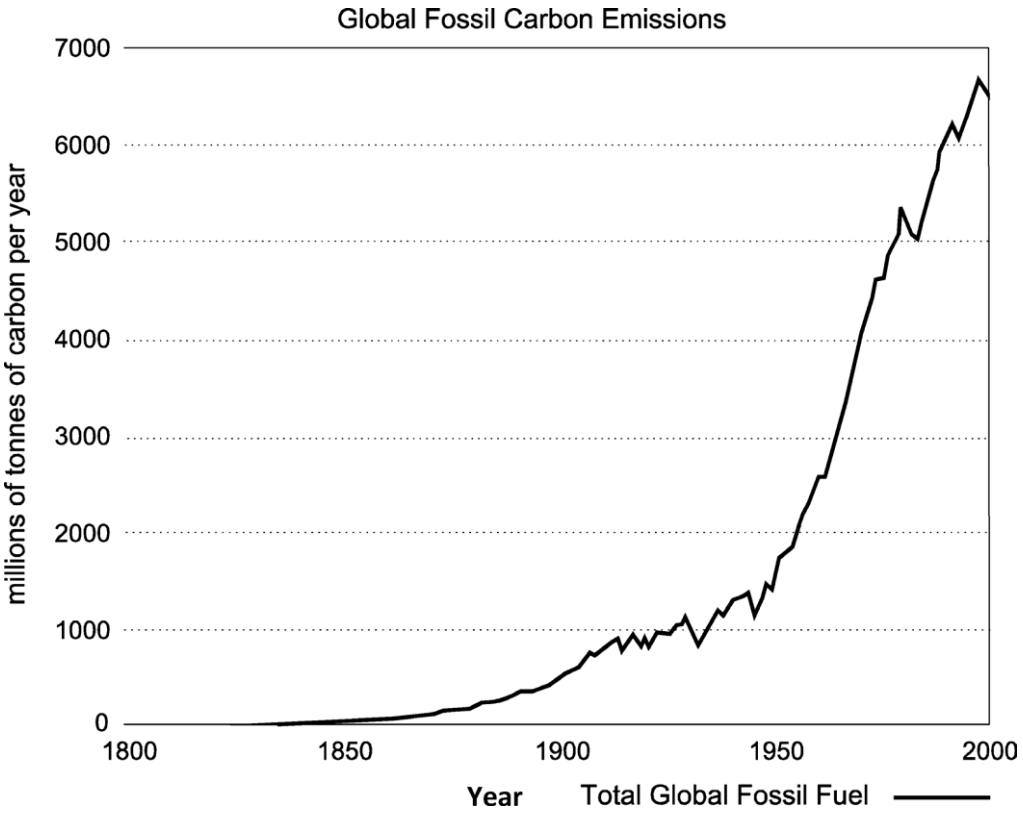
..... **[6]**

(b) Scientists are concerned about the changes in the levels of carbon dioxide in the modern atmosphere.

The graph below shows how the carbon dioxide in the Earth's atmosphere has changed in recent times.



The graph below shows the carbon emissions from fossil fuels over a similar period.



(i) Some scientists have identified correlations about factors which may affect the carbon dioxide levels in our atmosphere.

Describe the correlation between global carbon emissions and the level of carbon dioxide in the atmosphere shown by the graphs.

.....

.....

..... **[2]**

(ii) Scientists are worried about the amount of carbon dioxide in our atmosphere. Carbon dioxide contributes to the greenhouse effect.

Describe how carbon dioxide contributes to the greenhouse effect.

.....

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.....

..... **[4]**

END OF QUESTION PAPER

OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

GCSE (9–1) Combined Science B (Twenty First Century Science)
J260/02 Chemistry (Foundation Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 45 minutes

MAXIMUM MARK 95

This document consists of 17 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this component. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)
   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.
The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.
The communication statement determines the mark within a level.

Level of response question on this paper is 11(a).

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9–1) in Combined Science B:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>One similarity from:
Both have covalent bonds✓
Both contain carbon✓

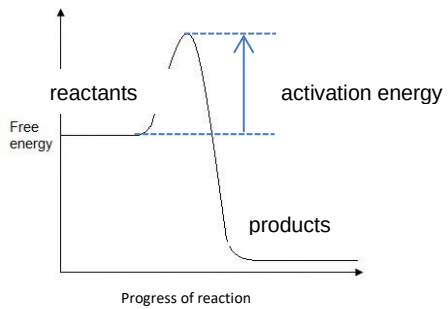
One difference from:
Diamond only contains one element but carbon dioxide contains two elements✓
Diamond has a giant (lattice) structure but carbon dioxide has a simple structure✓</td><td>2</td><td>1.1</td><td>IGNORE comments on melting/boiling points and state at room temperature</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Carbon ✓</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>
<table>
<tr><th>Property</th><th>True for diamond</th><th>True for graphite</th><th>True for both</th></tr>
<tr><td>Very hard so used as a cutting tool</td><td>✓</td><td></td><td></td></tr>
<tr><td>High melting point</td><td></td><td></td><td>✓</td></tr>
<tr><td>Conducts electricity</td><td></td><td>✓</td><td></td></tr>
<tr><td>Used as a lubricant</td><td></td><td>✓</td><td></td></tr>
</table>
</td><td>4</td><td>1.1</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
2	(a)		$2PbS + 3O_2 \longrightarrow 2PbO + 2SO_2$ ✓	1	2.2	One mark for correct balancing
	(b)	(i)	The lead has been reduced ✓	1	2.1	
		(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE if = 92.8(%) award 4 marks** RMM for PbO = 207.2 + 16.0 = 223.2 ✓ 207.2 ÷ 223.2 x 100 ✓ 92.8(%)✓ to 3 sig figs ✓	4	2.1	
		(iii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE if = 863(g) award 3 marks** 0.93 kg = 930 g ✓ 930 x 92.8 ÷ 100 ✓ = 863(g) ✓	3	2.1	**ECF**
	(c)	(i)	Disadvantages: noise / traffic / possible toxicity / dust ✓ Advantages: work / jobs / improved transport links / more facilities available ✓	2	3.2a	
		(ii)	Idea that it cannot be made completely safe / would take time for the mining company to improve safety ✓ Boosts local economy/ benefits outweigh risks ✓	2	3.2a	

Question			Answer	Marks	AO element	Guidance
3	(a)		For 100 atoms: 75.8 have RAM=35 24.2 have RAM=37 $\frac{75.8 \times 35 + 24.2 \times 37}{100}$ = 35.484 ✓ = 35.5 to 1 d.p. ✓	2	1.2	
	(b)	(i)	sodium + chlorine → sodium chloride ✓ 2Na(s) + Cl_2(g) → 2NaCl(s) ✓✓	3	1.1 1.2 1.1	One mark for word equation One mark for balancing at AO1.2 One mark for correct state symbols
		(ii)	Ionic because atoms show as charged/negative and positive Giant structure because many molecules of NaCl in the structure (all bonded together)	2	2.1	
		(iii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE if = 0.179 (nm^3) award 3 marks** 0.564 x 0.564 x 0.564 ✓ = 0.179 ✓ To 3 sig figs ✓	3	1.2	One mark for 3 sig figs
		(iv)	Shows 2 shared electrons between chlorine atoms ✓ Shows correct number of other electrons for each atom (6) ✓	2	1.1 2.2	**ALLOW** dots or crosses or a mixture of both
		(v)	Shows a total of 20 electrons ✓ In configuration 2,8,8 ✓	2	1.1 2.2	
	(c)		Giant ionic substances have higher melting points than simple covalent substances ✓ Ions are strongly attracted to each other ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
4	(a)		Description of use of equipment: • conical flask on balance with cotton wool in top of flask ✓ • hydrochloric acid and magnesium ribbon in the flask ✓ Variables: • same amount of magnesium ribbon and same volume of acid each time ✓ • vary concentration of acid ✓	4	**1.2** **1.2** **2.2** **2.2**	Up to two marks may be awarded for a correct diagram
	(b)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE if = 51(s) award 2 marks** 49 + 51 + 52 = 152 152 ÷ 3 = 50.6666 ✓ = 51 (s) ✓	**2**	**2.2**	
		(ii)	Magnesium powder larger surface area ✓ therefore Larger area for collisions with the acid ✓ Therefore faster reaction as more collisions per second ✓	**3**	**2.1** **1.1** **1.1**	

Question			Answer	Marks	AO element	Guidance
5	(a)		Tall column with condensers coming off at different heights ✓ Column heated at the bottom so hot at the bottom and cool at the top ✓ Substances with high boiling points condense at the bottom ✓ Substances with low boiling points condense at the top ✓	4	1.2	
	(b)		Only 5% petrol, need 22% too low ✓ Only 19% diesel, need 23% too low ✓	2	3.1a	
	(c)		Cracking ✓	1	1.1	
	(d)		Finite resource/does not get renewed/once used up cannot be replaced ✓ Crude oil is the main source of hydrocarbons ✓ Modern life depends on hydrocarbon for energy and feedstock for the petrochemical industry ✓	3	1.1	

Question			Answer	Marks	AO element	Guidance
6	(a)		 ✓✓	2	2.2	One mark for reactants and products **ALLOW** symbols for reactants and products One mark for activation energy
	(b)		Less ✓ Lost to ✓ Exothermic ✓	3	2.1	
7	(a)		Uses (25cm^3) pipette instead of measuring cylinder ✓ Uses a single indicator such as litmus or phenolphthalein instead of universal indicator ✓	2	3.3a	
	(b)		DCAB ✓✓	2	1.2	D and B correct one mark

Question			Answer	Marks	AO element	Guidance
8	(a)		Oxygen ✓	1	2.1	
	(b)		Group 0 ✓ Unreactive ✓ Does not react ✓	3	1.1 1.1 2.1	
9	(a)		Because it **(two from)** Uses least energy ✓ Uses least fossil fuel ✓ Produces least solid waste ✓ Gives least greenhouse gases ✓ Uses least water ✓	2	3.1b	
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE if = 55.7 (%) award 4 marks** 23.2 – 14.9 = 8.3 ✓ 8.3 ÷ 14.9 x 100 ✓ = 55.7 (%) ✓✓	4	2.1	One mark for one decimal place
	(c)		**One from:** Biodegradable - rots down in landfill ✓ Recyclable - can be re-used ✓ Sustainable - trees can be replaced ✓	1	2.1	
10	(a)		Bohr linked to electrons in shells ✓ Dalton linked to solid sphere ✓ Thomson linked to plum pudding model ✓	2	1.1	One mark if one correct Two marks if two or three correct
	(b)	(i)	Proton +1 ✓ Neutron neutral or 0 ✓ Electron -1 ✓	2	1.1	One mark if two correct Two marks if three correct
		(ii)	Atomic mass ✓ Properties ✓	2	1.1	
		(iii)	Gaps are for undiscovered elements/new elements ✓ He predicted properties / new elements matched his predictions / new elements had the properties he predicted ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
11	(a)*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Correctly describes how and why the water vapour condenses to make the oceans **And** Correctly describes how and why the carbon dioxide decreases initially after the formation of the oceans **And** Correctly links to a description how and why an oxygen rich atmosphere developed due to photosynthesising organisms producing oxygen and absorbing carbon dioxide leading to a decrease in carbon dioxide and increase in oxygen in the atmosphere *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated* **Level 2 (3–4 marks)** Correctly describes how and why the water vapour condenses to make the oceans **And** Correctly describes how and why the carbon dioxide decreases initially after the formation of the oceans *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	**6**	**2 x 2.1** **2 x 3.1a** **2 x 3.2b**	**Indicative scientific points may include** **AO3.1a links to levels of the gases** For example: • Water vapour decreases • Carbon dioxide decreases • Oxygen increases **AO3.2b linked to a conclusion why these gases changed** For example: • Dissolving in the oceans • Forming sedimentary rocks • By photosynthesis • Earth starts hot, cools • Water condenses to form oceans **AO2.1 Links description of the development of oxygen rich atmosphere to appearance of plants** For example: • First bacteria appeared (cyanobacteria) • These photosynthesised • Removing carbon dioxide by using it to make glucose and releasing oxygen into the atmosphere • Slowly the oxygen increased and the carbon dioxide levels decreased

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Correctly describes that the water vapour decreases with a valid reason **Or** Correctly identifies that the carbon dioxide decreases with a valid reason **Or** Correctly identifies that oxygen increases with a valid reason *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.			
	(b)	**(i)**	Carbon dioxide increases over the period ✓ Carbon emissions from fossil fuels increases ✓	**2**	**2.2**	
		(ii)	CO_2 builds in the atmosphere around the earth ✓ Radiation from the sun enters through the atmosphere some is absorbed by the earth and some of this radiation is reflected by the Earth ✓ Radiation instead of going into space is reflected back to the earth by the CO_2 in the atmosphere ✓ Causing the earth to increase in temperature ✓	**4**	**2.1**	

Summary of updates

Date	Version	Details
May 2018	2	We've reviewed the look and feel of our papers through text, tone, language, images and formatting. For more information please see our assessment principles in our "Exploring our question papers" brochures on our website
March 2019	2.1	Amended Question 6(a) in the Mark Scheme to show the activation energy is represented by a single headed arrow showing an increase in energy.
December 2021	2.3	Updated copyright acknowledgements.
September 2024	2.4	Updated the font of oxidation numbers.