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Oxford Cambridge and RSA

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

F

J260/02 Chemistry (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

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.

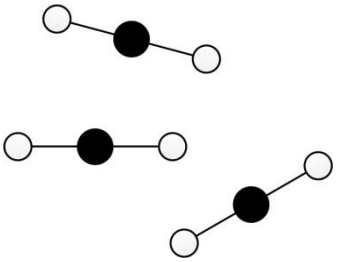
INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in the question marked with an asterisk (*).
- This document consists of **24** pages.

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.

[1]

calcium **carbon** **nitrogen** **sulphur** **iron**

() 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 lead ore 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. The word equation for this reaction is:

lead sulfide + oxygen $\longrightarrow$ lead(II) oxide + sulfur dioxide

Complete the balanced symbol equation for this reaction.

$2PbS + \text{.....}O_2 \longrightarrow 2PbO + \text{.....}SO_2$ **[1]**

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

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

(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 **three** significant figures.

……% **[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.

……..g **[3]**

(c) Sonita and Clive 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.

The lead mine affects the surrounding area because they have to blast out 10 tonnes of rock to get less than a tonne of lead.

Clive

Yes, but the mine employs many of the local people.

Sonita

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

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

……..

……..

…….. **[2]**

(ii) Sonita and Clive talk about the processing of the lead at the mine.

Some of the waste from processing lead ore is toxic. I think we should close the mine until the process can be made completely safe.

Clive

Suggest reasons that Sonita 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 and chlorine-37 with an atomic mass of 37. The percentage abundance of these isotopes is shown in the table below.

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

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

[2]

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

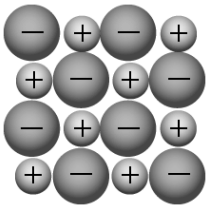
Complete the word and symbol equations for the reaction.

…… + …… ⟶ ……

.....Na(s) + Cl_2(.....) ⟶ ….....NaCl(.....)

[3]

(ii) Sodium chloride has a giant ionic structure.



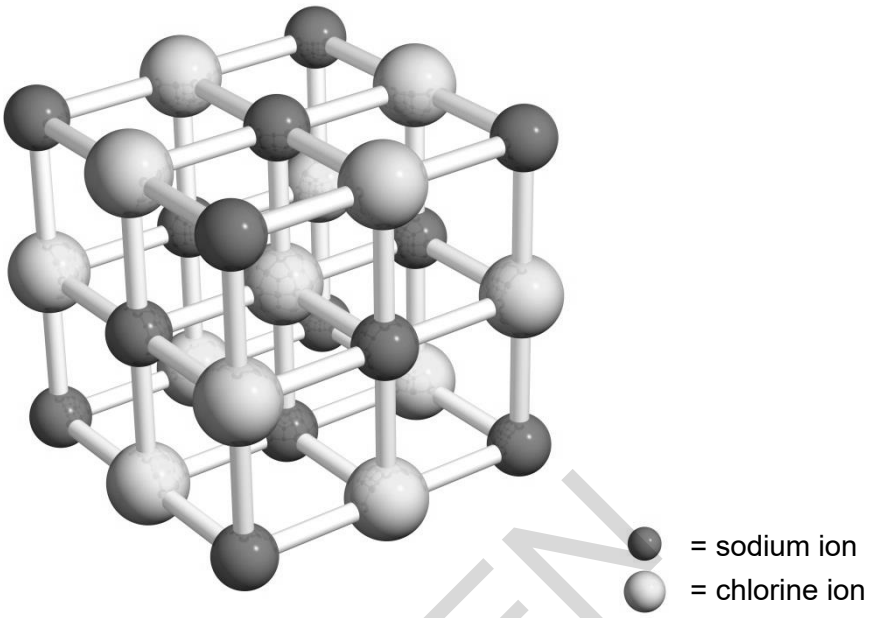
How can you tell this from the diagram?

……

……

…… **[2]**

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



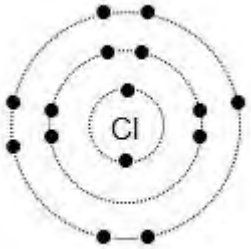
The C*l*–Na–C*l* length of a crystal of sodium chloride is 0.564nm.

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

Give your answers to **three** significant figures.

volume = ……nm^3 **[3]**

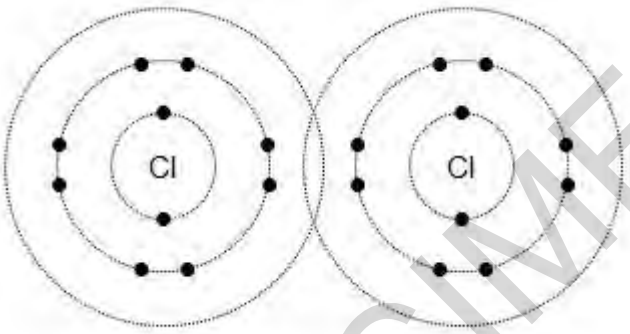
(iv) The diagram shows the arrangement of electrons in a chlorine atom.



Chlorine atom

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

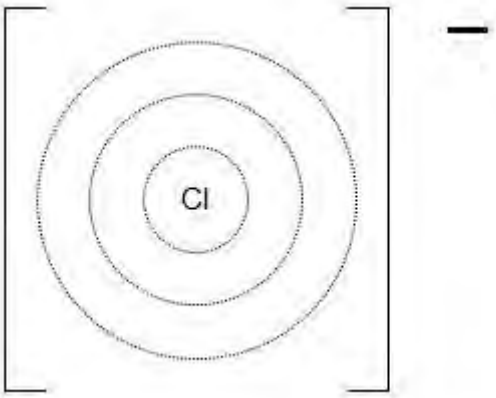
Complete the diagram to show the arrangement of electrons in a chlorine molecule.



[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 °C
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. ☐

There are strong bonds between simple covalent molecules. ☐

Ions are strongly attracted to each other. ☐

Ionic substances dissolve easily. ☐

[2]

4 Adnan 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

$Mg + 2HCl \longrightarrow MgCl_2 + H_2$

(a) Adnan wants to investigate the effect of concentration of the acid on the reaction when hydrochloric acid reacts with magnesium.
He uses the following equipment:

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

Describe how Adnan would do this investigation.

You may include a diagram in your answer.

……

……

……

……

……

…….. **[4]**

(b) Adnan does another experiment. This time 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 Adnan's results table by calculating the mean value for his experiment using magnesium powder. Give your answer to the nearest second.

……..s **[2]**

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

Explain why.

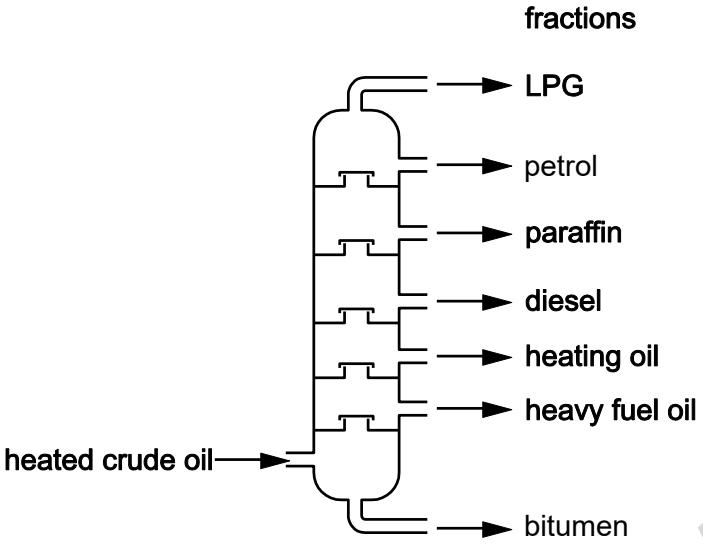
……...

……...

…… **[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 below 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

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

Use information from the table to show that Karen'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.

crystallisation **filtration** **evaporation** **cracking** **[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.

.....

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.....

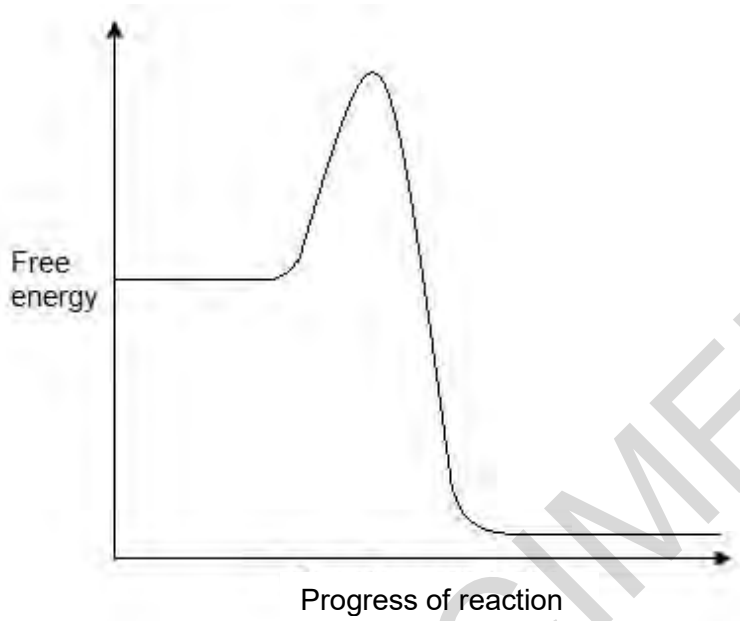
.....

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

6 Self-heating food packs are available on the internet. They warm food using a chemical reaction. They often use the reaction between calcium oxide and water.

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

(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 Wei-Lin 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:

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

Here are Wei-Lin'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

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

For her first test, Wei-Lin 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 Wei-Lin 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.

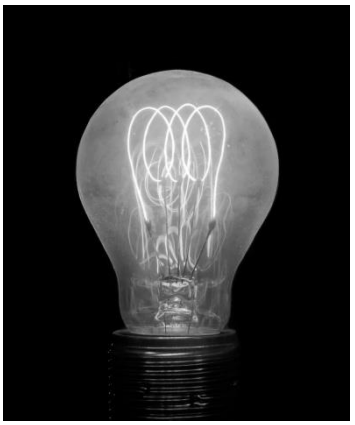
They are not in the correct order.

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.

Nitrogen	☐
Oxygen	☐
Carbon dioxide	☐
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 solves the problem Joseph Swan had with his light bulb.

Use the words or phrases from the list.

Group 0
Group 1
Group 7
reactive
unreactive
reacts
does not react

Argon is in …….. of the Periodic Table.

Argon is very ……

[3]

Therefore, the argon …….. with the carbon in the filament.

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 below.

	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.....

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2.....

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[2]

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

From the table, calculate, in 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 one decimal place.

……..**%** **[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 straight 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.

	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]**

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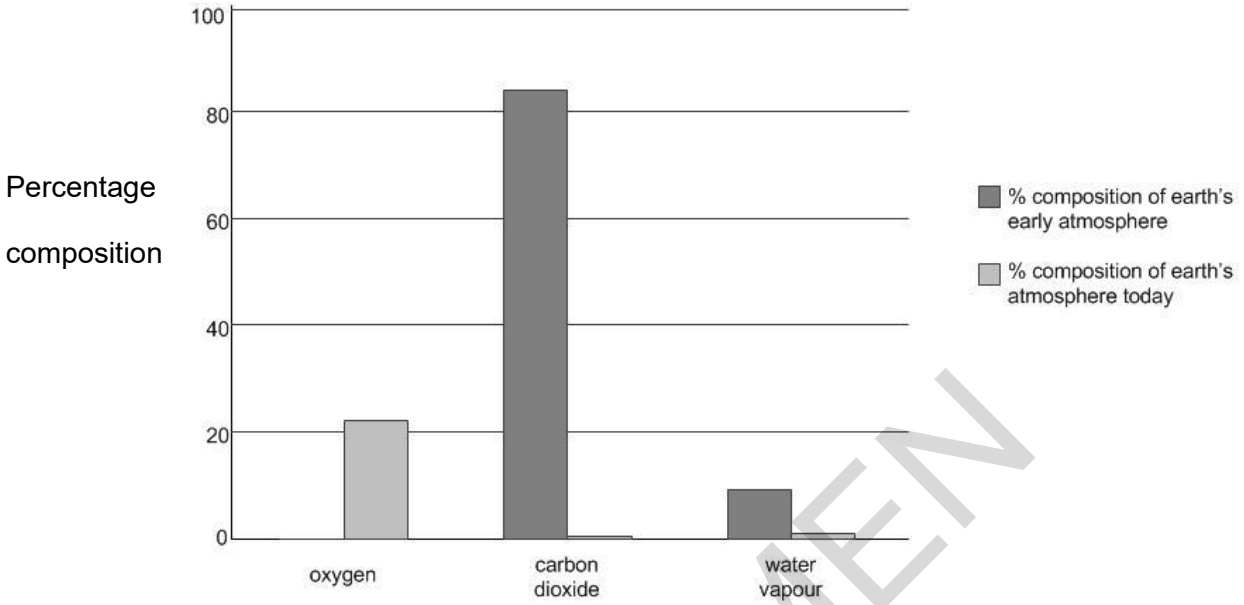
PLEASE TURN OVER FOR THE NEXT QUESTION

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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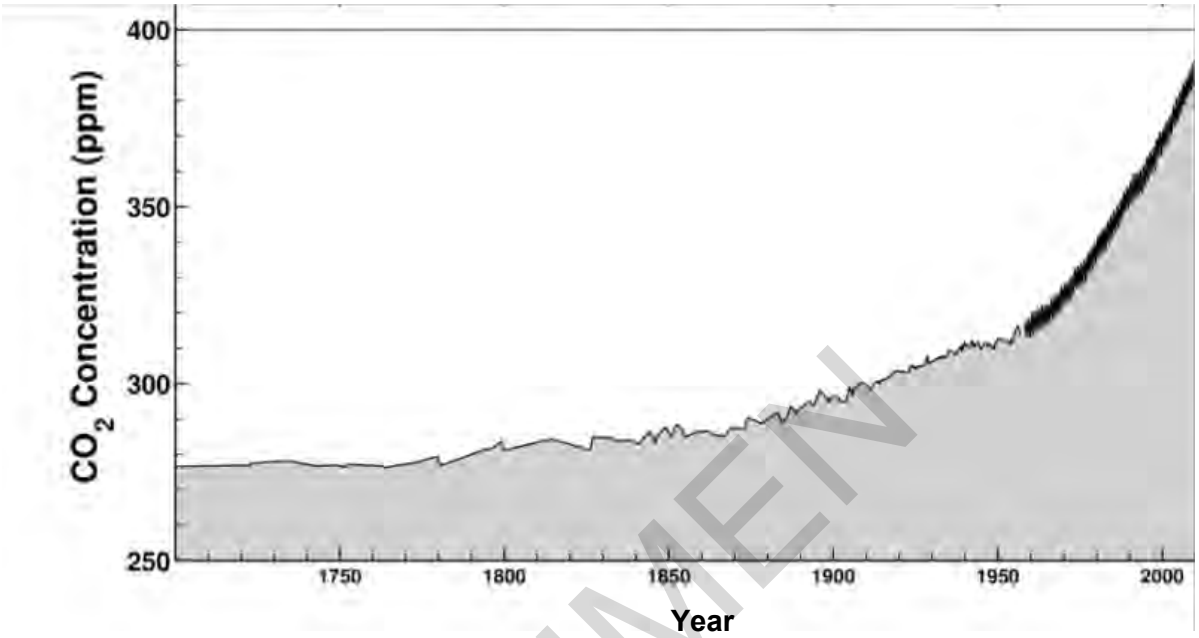
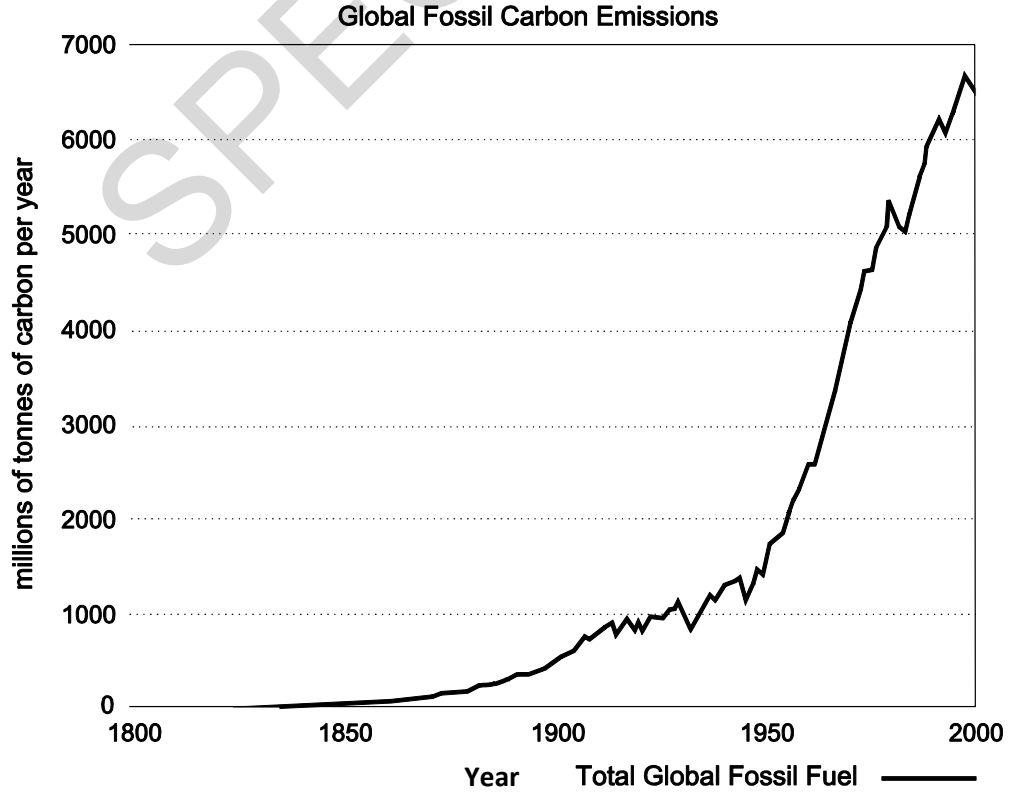
…….. **[6]**

(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