OCR
Oxford Cambridge and RSA

Accredited

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

H

J260/06 Chemistry (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (mm/cm)
- 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 **20** pages.

Answer **all** the questions.

1 (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.

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…… **[2]**

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

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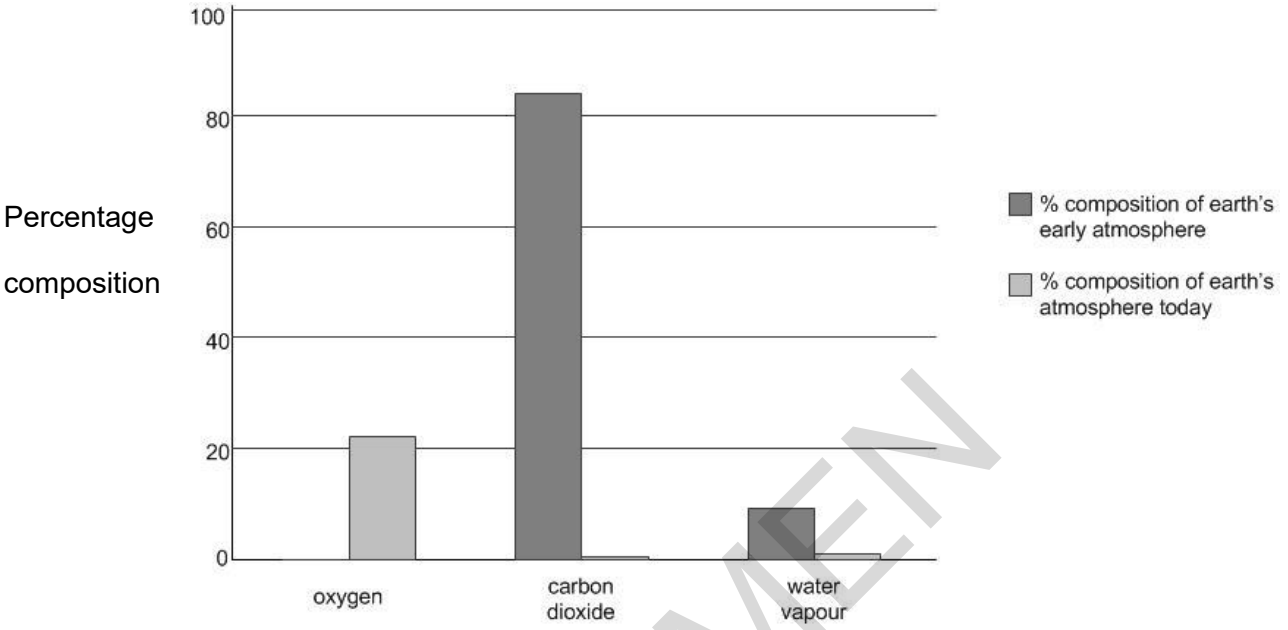
…… **[2]**

2 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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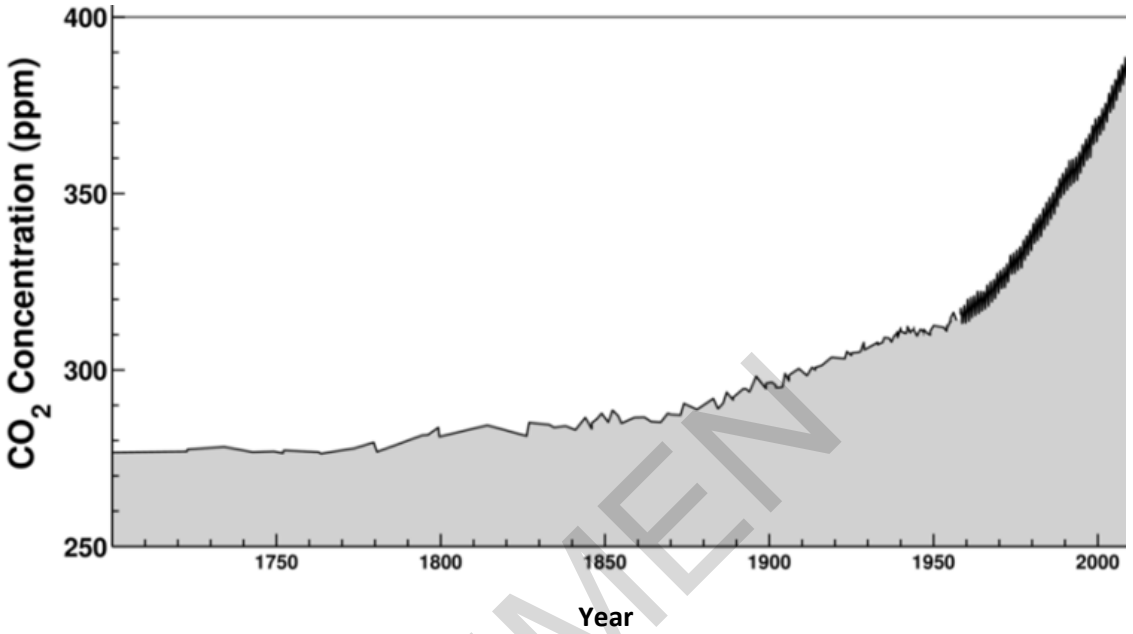
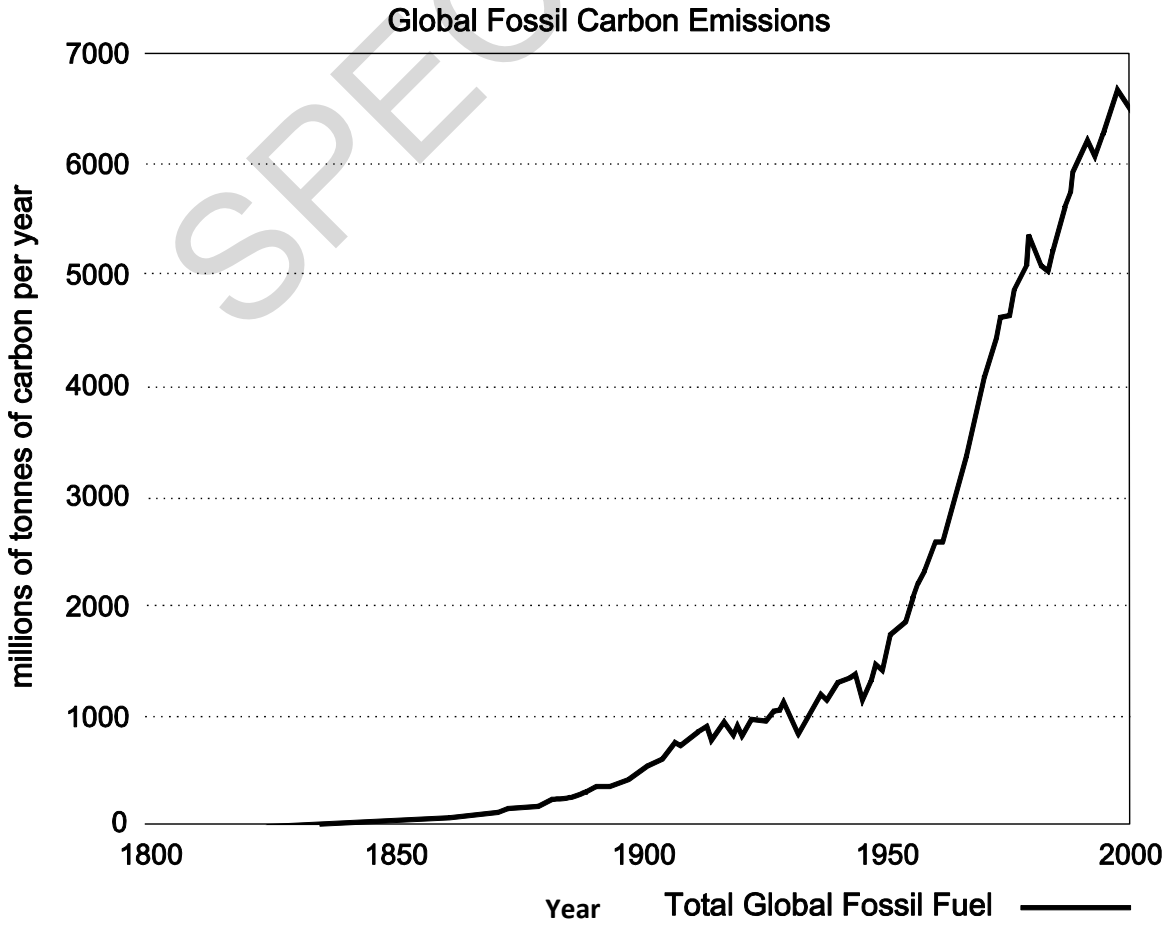
…… **[6]**

(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.

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……. **[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]**

3 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

Write a balanced symbol equation for this reaction.

…….. **[3]**

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

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

(i) Explain what has happened to the lead in this reaction.

…… **[1]**

(ii) What is the maximum mass of lead that can be extracted from 1.116 kg of lead(II) oxide?

……g **[4]**

(iii) Why is carbon used to extract lead from its ore but not aluminium?

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…… **[2]**

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

They found out some facts about the mine.

Employment at the mine	1000 persons
Lead found in house dust in houses local to the mine	1000 μg/m²
Amount of rock blasted out to obtain one tonne of lead	10 tonnes
Toxicity of lead	High

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

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

Advantage ……

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Disadvantage ……..

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[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.

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…… **[2]**

(d) The waste material from the ore still contains some lead and can contaminate the surrounding soil.

One way of cleaning up contaminated soil is to use phytoextraction.

Describe how phytoextraction can be used to clean up the contaminated soil.

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…… **[3]**

4 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 a salt.

Write a balanced symbol equation for the reaction.

Include state symbols in your answer.

[3]

(ii) The salt formed has a very high melting point.

Explain how the bonding and structure accounts for this high melting point.

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…… **[3]**

5 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 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.

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…….. **[4]**

(b) Adnan uses 0.116 g of magnesium each time in his experiment. He measures the time until all the magnesium is used up. He uses both magnesium ribbon and magnesium powder.

Here are his results:

Concentration of hydrochloric acid (mol/dm^3)	1.5	1.0	0.5
Reaction time using magnesium ribbon (seconds)	88	165	209
Reaction time using magnesium powder (seconds)	55	93	121

(i) From Adnan's results, describe the effect of concentration on the rate of reaction. Use information from the table in your answer.

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……. **[2]**

(ii) The mean rate of reaction for the magnesium ribbon with 1.5 mol/dm^3 hydrochloric acid is 1.32×10^{-3} g/s.

Calculate the mean rate of reaction for the magnesium powder with 1.5 mol/dm^3 hydrochloric acid**.**
Give your answer in standard form and to **three** significant figures.

…….g/s **[4]**

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

Explain why.

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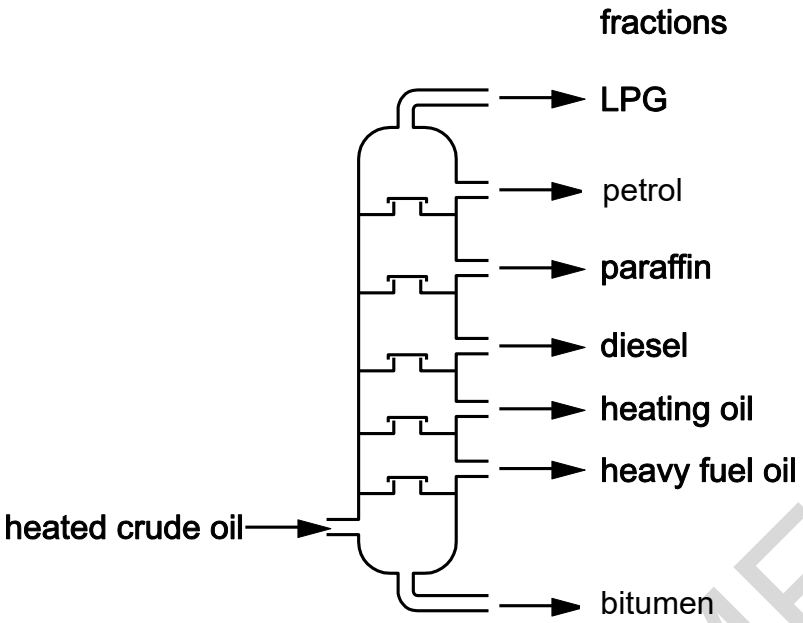
……. **[2]**

6 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) Describe **how** crude oil is separated using a fractionating column.

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

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

The fractions are listed in increasing order of carbon chain length.

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

The table shows that only about a quarter of the petrol needed is supplied by fractional distillation of crude oil.

Explain how an oil refinery uses cracking to increase the production of petrol.

Use information from the table in your answer.

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…… **[2]**

7 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.

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

This reaction gives out heat.

(a) Draw and label a reaction profile for this reaction. Label the activation energy.

[3]

(b) Explain the relationship between activation energy and catalysts.

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…… **[2]**

8 Wei-Lin is a chemistry technician in a secondary school. She has found some bottles of hydrochloric acid where the labels have fallen off.

She decides to do a titration of the contents against 1.0 mol/dm^3 sodium hydroxide to find the concentration of the acid in each bottle.

(a) The balance symbol equation for this reaction is:

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

(i) Wei-Lin found that 30 cm^3 of sodium hydroxide neutralised 25 cm^3 of the acid from one of the bottles.

Calculate the concentration of the acid from this bottle.

concentration = ……mol/dm^3 **[4]**

(ii) Wei-Lin works out that the concentration of acid in one of the other bottles to be 2.0 mol/dm^3.

She wishes to make 500 cm^3 of 0.1 mol/dm^3 hydrochloric acid from this acid to fill up the bottles in the laboratory.

Calculate the volume of the 2.0 mol/dm^3 acid she would have to use.

volume = ……..cm^3 **[3]**

(b) Students use the 0.1 mol/dm^3 hydrochloric acid and calcium carbonate to make the soluble salt calcium chloride.
The students make a dry sample of the calcium chloride crystals.

Describe how they do this.

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……. **[4]**

(c) The balanced symbol equation for this reaction is:

$$2HCl + CaCO_3 \longrightarrow CaCl_2 + H_2O + CO_2$$

The students wish to calculate the maximum amount of calcium chloride they could make from 200 cm^3 of 0.1 mol/dm^3 hydrochloric acid.

Calculate the maximum mass of calcium chloride they could produce.

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

maximum mass of calcium chloride……g **[6]**

(d) Hydrochloric acid is a strong acid, ethanoic acid is a weak acid.

The equations for the acids in solution are:

$$HCl \longrightarrow H^+ + Cl^-$$

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

Explain the differences in these acids and their pH.

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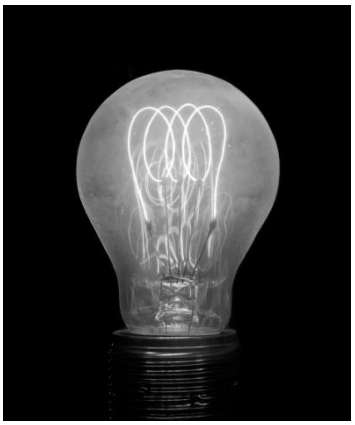
..... **[3]**

9 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.

Explain why these bulbs did not last very long.

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…… **[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.

Explain how using a glass bulb filled with argon solved the problem Joseph Swan had with his light bulb.

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…… **[3]**

10 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

By evaluating the information in the table, decide which of the three materials is best to use for shopping bags.

Explain your choice.

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…… **[3]**

END OF QUESTION PAPER