OCR
Oxford Cambridge and RSA

Tuesday 11 June 2024 – Morning

GCSE (9–1) Combined Science A (Gateway Science)

J250/10 Chemistry (Higher Tier)

Time allowed: 1 hour 10 minutes

H

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science A (Chemistry) (inside this document)

You can use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

Section A

You should spend a **maximum** of **20 minutes** on this section.

Write your answer to each question in the box provided.

1 Carbon reacts with copper oxide to produce copper.

copper oxide + carbon → copper + carbon dioxide

What is the role of the carbon?

A It is a catalyst.

B It neutralises the copper oxide.

C It oxidises the copper oxide.

D It reduces the copper oxide.

Your answer ☐ **[1]**

2 A teacher investigates some reactions of chlorine.

Why is it important that the teacher does **not** breathe in chlorine?

A Chlorine is highly flammable.

B Chlorine is inert.

C Chlorine is strongly alkaline.

D Chlorine is toxic.

Your answer ☐ **[1]**

3 Where do scientists think that the oxygen in the Earth's atmosphere came from?

A Earthquakes

B Green plants

C Thunderstorms

D Volcanic activity

Your answer ☐ **[1]**

4 Which of the catalysts is an example of an **enzyme**?

A Alumina – used in the cracking of hydrocarbons

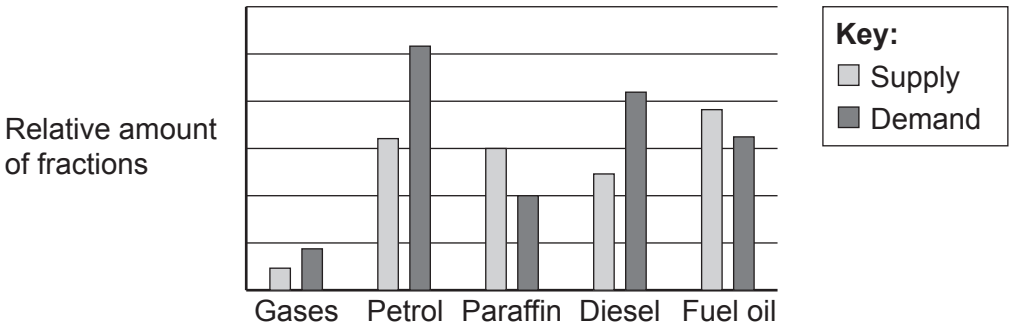
B Copper – used in the reaction between zinc and dilute sulfuric acid

C Lipase – used to help humans absorb fats

D Manganese oxide – used in the decomposition of hydrogen peroxide

Your answer ☐ **[1]**

5 The graph shows the supply and demand of different fractions of crude oil.



Which fractions are most likely to be cracked to make the supply match the demand?

A Diesel and fuel oil

B Gases and petrol

C Paraffin and fuel oil

D Petrol and diesel

Your answer ☐ **[1]**

6 Acid rain is a **dilute** solution of a **weak** acid.

What is the pH of acid rain?

A 1–2

B 4–5

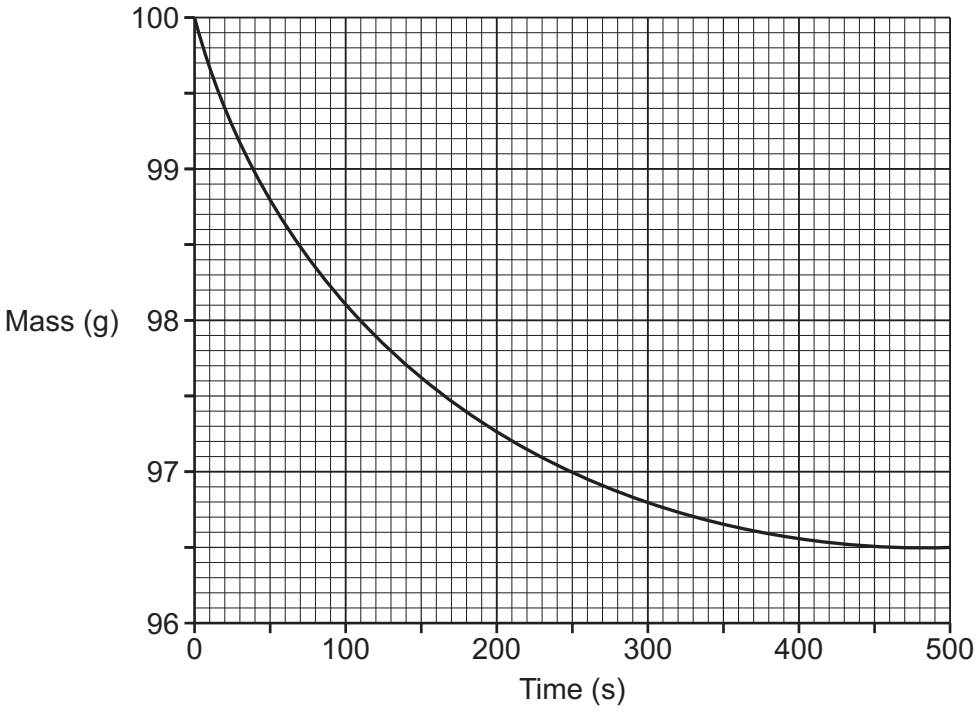
C 8–9

D 13–14

Your answer ☐ **[1]**

7 A student investigates the rate of reaction between marble chips and dilute hydrochloric acid.

The graph shows how the mass of the reactants changes during the reaction.



What are the units for the rate of reaction?

A g

B g/s

C s

D s/g

Your answer ☐ **[1]**

8 Which method of extracting metals involves growing plants in soil that contains metal compounds?

A Bioleaching

B Decomposition

C Phytoextraction

D Reduction

Your answer ☐ **[1]**

9 Fluorine gas reacts with sodium to form sodium fluoride.

What is the **balanced half equation** for the reaction of fluorine when it reacts with sodium?

A $F + e^- \rightarrow F^-$

B $F \rightarrow F^- + e^-$

C $F_2 + 2e^- \rightarrow 2F^-$

D $F_2 \rightarrow 2F^- + 2e^-$

Your answer ☐ **[1]**

10 Methanol, CH_3OH, can be made by reacting carbon monoxide, CO, with hydrogen, H_2.

$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$

The forward reaction is exothermic.

Which change in temperature **and** pressure will move the position of equilibrium to the **right**?

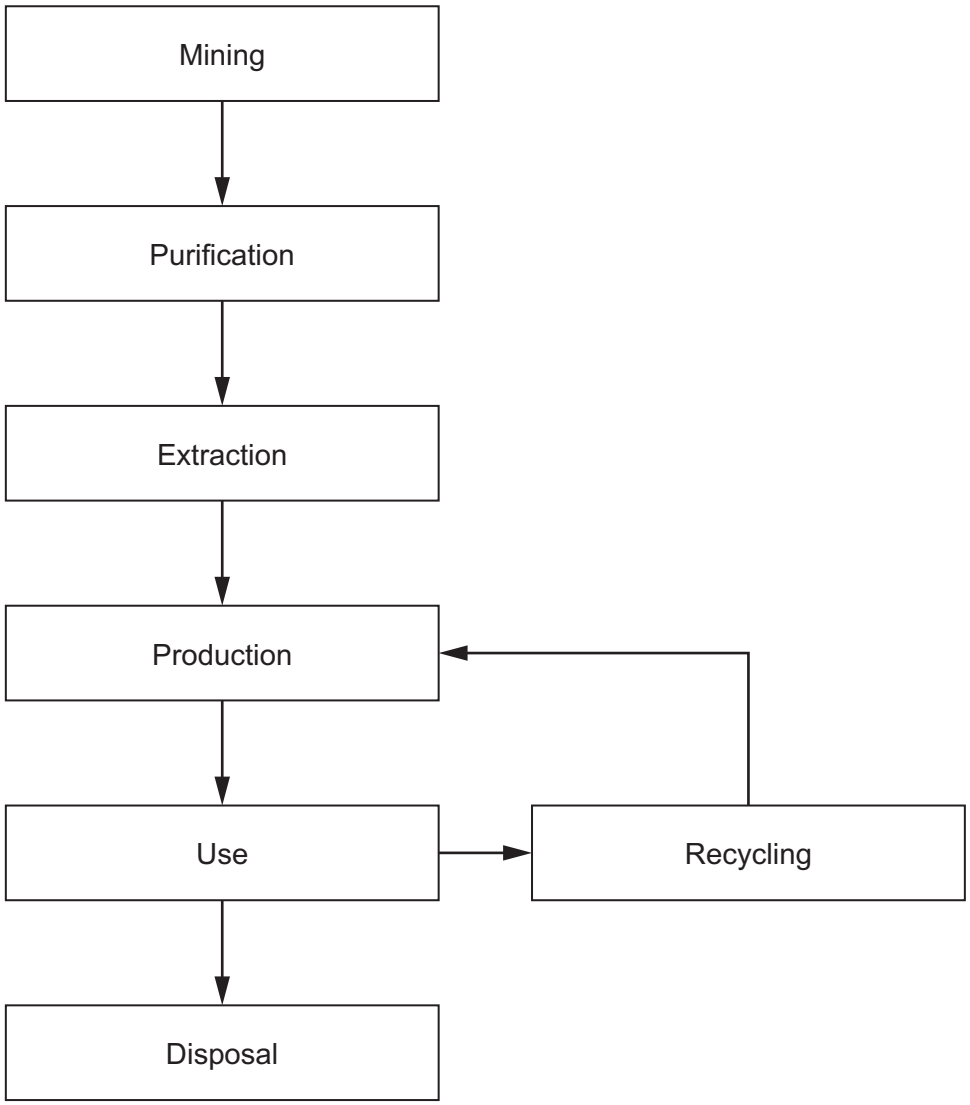
	Change in temperature	**Change in pressure**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

Your answer ☐ **[1]**

Section B

11 Aluminium is extracted from a rock called bauxite which contains aluminium oxide.

The diagram shows information from a life-cycle assessment for the manufacture and use of aluminium products.



(a) Give **one** reason why a life-cycle assessment is carried out.

.....

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

(b) Give **two** reasons why the products should be recycled at the end of their useful life.

1 .....

.....

2 .....

.....

[2]

(c) 18% of the bauxite rock is turned into aluminium.

Calculate the mass of aluminium that is extracted from 7500 kg of bauxite.

Give your answer to **2** significant figures.

Mass of aluminium = ... kg **[3]**

(d) During the purification, aluminium oxide, Al_2O_3, is produced from aluminium hydroxide, $Al(OH)_3$.

Complete the **balanced symbol** equation for the reaction.

$$.....Al(OH)_3 \longrightarrow Al_2O_3 + ...H_2O$$

[2]

(e) Aluminium is extracted from aluminium oxide, Al_2O_3, by electrolysis.

(i) This is the equation for the electrolysis of aluminium oxide.

$$2Al_2O_3 \longrightarrow 4Al + 6O_2$$

A student thinks that this reaction is an example of reduction.

Explain why the student is **correct**.

.....

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

(ii) Extracting aluminium by electrolysis is expensive.

Which statements about why the electrolysis is expensive are **true**, and which are **false**?

Tick **one** (✓) box in each row.

	True	**False**
Aluminium oxide is melted at a high temperature.		
The electrolysis produces impure aluminium.		
The electrolysis uses large amounts of electricity.		

[2]

(iii) It would be cheaper if aluminium could be extracted by heating the aluminium oxide with carbon.

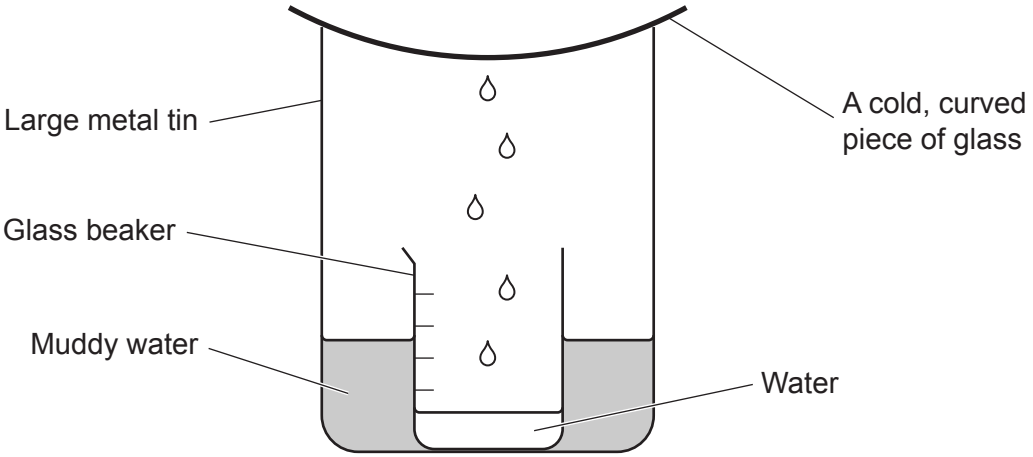
Explain why aluminium oxide does **not** react with carbon.

.....

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

12 A student does an experiment to separate water from muddy water.

The diagram shows the equipment they use.



The student leaves the equipment in a sunny place.

Explain how the student's equipment separates water from muddy water.

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

13 Crude oil is a mixture of useful hydrocarbons which are separated into fractions.

(a) Which statement describes why crude oil is called a **feedstock** for the petrochemical industry?

Tick **one** (✓) box.

It's a naturally occurring finite resource. ☐

It's a source of environmentally friendly fuels. ☐

It's used to produce other chemicals. ☐

[1]

Table 13.1 shows some information about the fractions in crude oil.

Table 13.1

Fraction	Boiling point (°C)	Percentage in crude oil (%)
U	20–200	28
V	above 450	2
W	350–450	.....
X	below 20	4
Y	250–350	15
Z	200–250	21

(b) Calculate the percentage of fraction **W** found in crude oil.

Write your answer in **Table 13.1**.

[1]

(c) The boiling point of a fraction depends on the number of carbon atoms in the molecules.

Complete **Table 13.2** by writing in the letters of **three** fractions shown in **Table 13.1**.

Table 13.2

Number of carbon atoms in the molecules	Fraction
1–4	.....
5–11	.....
12–14	.....

[2]

(d) Write the letter of the fraction shown in **Table 13.1** which has the **strongest** intermolecular forces.

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

(e) Many of the hydrocarbons in crude oil are alkanes.

(i) Write the **general formula** for an alkane.

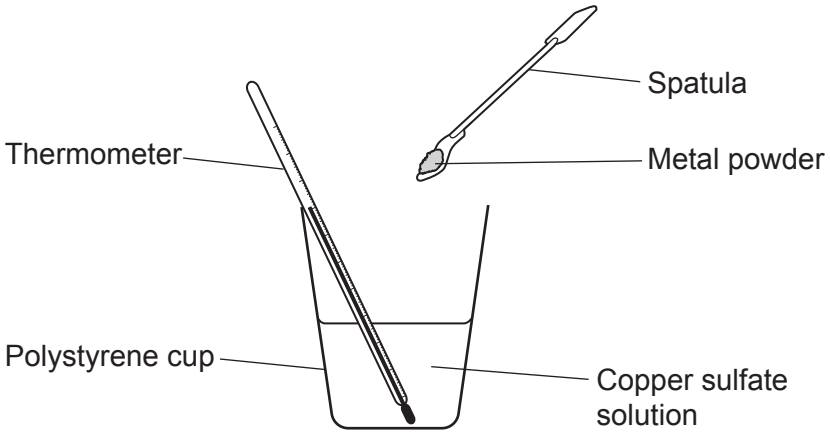
..... **[1]**

(ii) Write the formula for an alkane with **14** carbon atoms.

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

14 A student investigates the reactivity of four metals.

The diagram shows the equipment they use.



This is their method:

- Measure 25 cm^3 of copper sulfate solution into a polystyrene cup.
- Measure and record the initial temperature of the copper sulfate solution.
- Add two spatulas of a powdered metal and stir the mixture.
- Record the highest temperature reached.

The table shows some of the student's results.

Metal	Initial temperature (°C)	Highest Temperature (°C)	Temperature change (°C)
Tin		34.1	17.8
Zinc		43.6	27.5
Iron		29.7	13.6
Magnesium		47.2	31.0

(a) Calculate the **lowest** initial temperature of the copper sulfate solution.

Lowest initial temperature = ... °C **[1]**

(b) Use the student's results to list the metals in the order of reactivity **obtained by the student**.

Most reactive .....

.....

.....

Least reactive .....

[1]

(c) The student's results put the reactivity of iron and tin in the **incorrect** order.

(i) The student thinks that the error could be because they added incorrect masses of each metal.

What piece of equipment could the student use to get a more accurate measurement of the mass of each metal?

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

(ii) Another student thinks that the error could be because the iron powder used is old and its surface has been oxidised.

Describe and explain how this oxidation could have affected the results for iron.

.....

.....

.....

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

(d) The balanced symbol equation for the reaction between magnesium and copper sulfate solution is:

$Mg(s) + CuSO_4(aq) \rightarrow MgSO_4(aq) + Cu(s)$

The reaction can be written as an ionic equation.

Complete the **balanced ionic** equation for the reaction.

$$Mg + Cu^{2+} \longrightarrow \text{.....} + \text{.....}$$

[2]

15 The amount of carbon dioxide in the Earth's atmosphere has changed over time.

(a) What is the percentage of carbon dioxide found in the Earth's atmosphere today?

Tick **one** (✓) box.

0.04% ☐

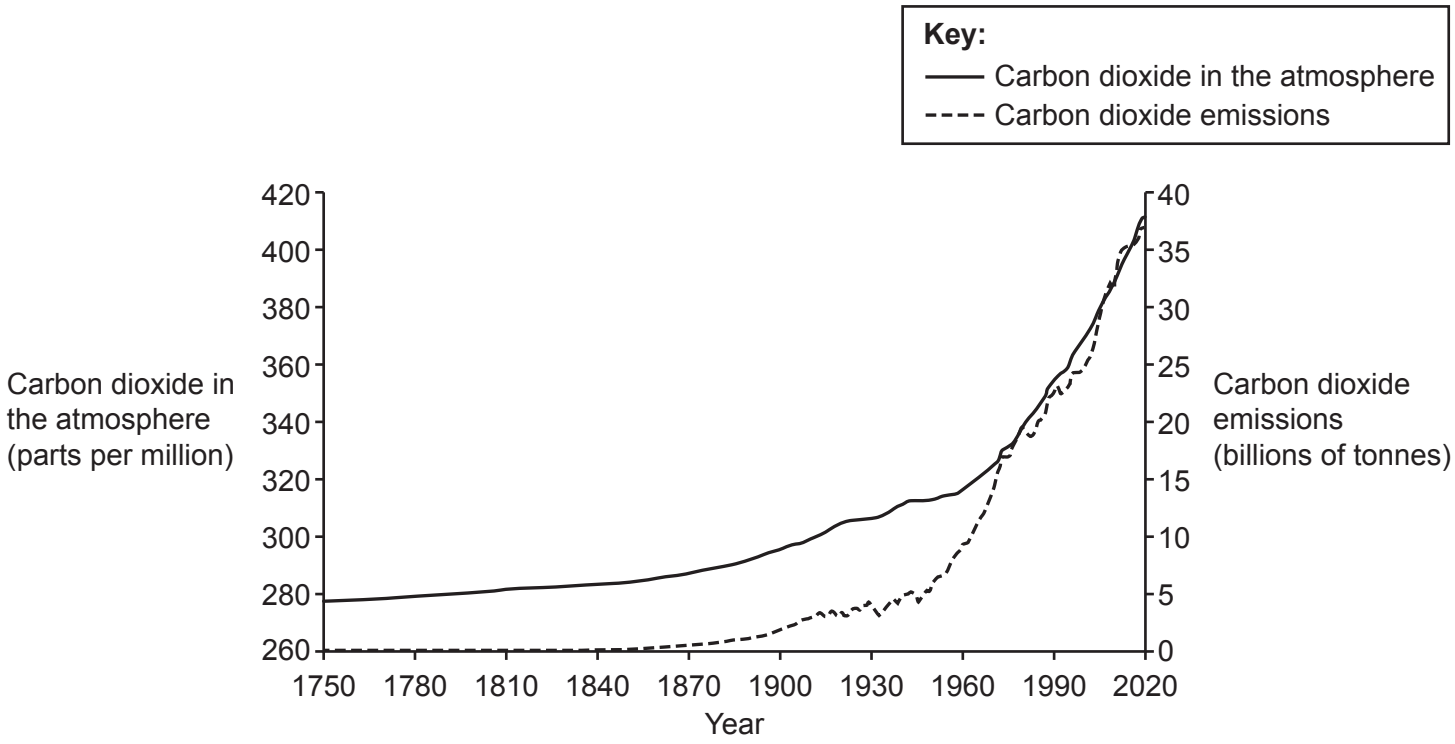
0.4% ☐

4% ☐

[1]

(b) Most scientists think that the amount of carbon dioxide in the Earth's atmosphere is being increased by human activity.

The graph shows the carbon dioxide in the atmosphere and carbon dioxide emissions from 1750–2020.



(i) Describe the correlation between carbon dioxide in the atmosphere and carbon dioxide emissions.

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.....

.....

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

(ii) Give **one** reason for the change in carbon dioxide emissions after 1960.

.....

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

(c) It is thought that an increase in carbon dioxide in the atmosphere is causing global warming.

(i) Describe how an increase in carbon dioxide in the atmosphere is causing global warming.

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

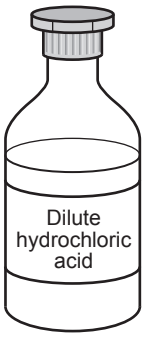
(ii) Describe **one** way that the emissions of carbon dioxide by human activity can be reduced.

.....

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

16* A student investigates the rate of reaction between magnesium and an excess of dilute hydrochloric acid.

Strip of magnesium



Dilute hydrochloric acid

The student does three experiments. In the experiments they use the same length of magnesium but change one other variable.

The table shows the results of the three experiments.

Experiment	Time for the magnesium to react (s)
1	37
2	26
3	19

Describe the method the student used to get these results, including the variable they may have changed and the variables they controlled.

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

17 The elements in Group 1 of the Periodic Table show trends in their properties.

The table shows the diameter of atoms and arrangement of electrons for the first three elements in Group 1.

Element	Diameter of atoms (m)	Arrangement of electrons
Lithium	3.04×10^{-10}	2, 1
Sodium	3.72×10^{-10}	2, 8, 1
Potassium	4.54×10^{-10}	2, 8, 8, 1

(a) Describe and explain the trend in the diameter of atoms of the elements in Group 1.

.....

.....

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

(b) Rubidium is the element below potassium in Group 1.

Predict the diameter of atoms of rubidium.

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

(c) Describe and explain how the diameter of the atoms affects the reactivity of the elements in Group 1.

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

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.