

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 2 Chemistry Extension

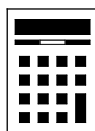
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Thursday 3 November 2022 07:00 GMT Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a pencil and a ruler
- a scientific calculator
- the periodic table (enclosed).



Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.
- You are expected to use a scientific calculator where appropriate.
- The periodic table is provided as a loose insert.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
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6	
7	
8	
TOTAL	



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ANSWER IN THE SPACES PROVIDED**



Answer **all** questions in the spaces provided.

0 1

Alkanes and alkenes are hydrocarbons.

0 1 . 1

The general formula of an alkane is C_nH_{2n+2}

An alkane is produced when 2 moles of carbon (C) combine with 3 moles of hydrogen (H_2).

Complete the molecular formula of this alkane.

[1 mark]

C _____ H _____

Alkenes are unsaturated hydrocarbons.

0 1 . 2

Give the general formula for alkenes.

[1 mark]

0 1 . 3

What is meant by 'unsaturated'?

[1 mark]

0 1 . 4

What is meant by 'hydrocarbon'?

[1 mark]

0 1 . 5

Name a substance used to test for the presence of an alkene.

[1 mark]

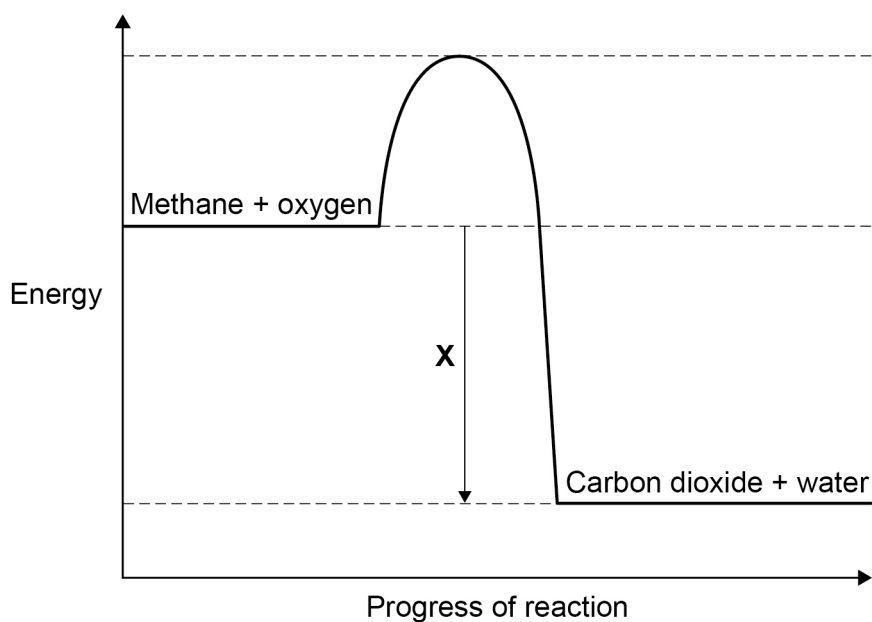
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Methane (CH_4) is used as a fuel.

Figure 1 shows the energy level diagram for the complete combustion of 1 mole of methane.

Figure 1

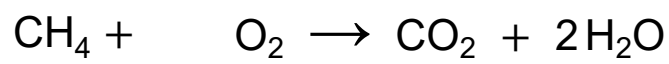


0 1 . 6 What does the energy change labelled **X** on **Figure 1** represent?

[1 mark]

0 1 . 7 Balance the equation for the complete combustion of methane.

[1 mark]



0 1 . 8

During the complete combustion of methane:

- existing bonds are broken
- new bonds are formed.

Explain why the energy change labelled **X** in **Figure 1** has a negative value.

Refer to the energy changes when bonds are broken and formed.

[2 marks]

9

Turn over for the next question

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0 2

A student investigated the thermal decomposition of Group 2 metal carbonates.

The word equation for the reaction is:



This is the method used:

1. Record the mass of an empty boiling tube
2. Add the metal carbonate to the boiling tube and record the total mass
3. Heat the boiling tube and metal carbonate for 3 minutes
4. Allow the boiling tube and contents to cool
5. Record the mass of the boiling tube and contents
6. Repeat steps 3 to 5.

0 2 . 1

Suggest why the student repeated steps 3 to 5 of the method.

[1 mark]

The student calculated the mass of the metal carbonate and the mass of the metal oxide.

Table 1 shows the results.

Table 1

Name of metal carbonate	Formula of metal carbonate	Relative formula mass (M_r) of metal carbonate	Mass of metal carbonate in grams	Mass of metal oxide in grams
Magnesium carbonate	MgCO ₃	84	2.1	1.0
Calcium carbonate	CaCO ₃	100	2.5	1.4
Strontium carbonate	X	148	3.7	2.6



0 2 . 2 Calculate the number of moles of magnesium carbonate used in the investigation.

Use **Table 1**.

[2 marks]

Number of moles = _____

0 2 . 3 The formula of strontium carbonate is represented by **X** in **Table 1**.

Determine the formula of strontium carbonate.

Use the periodic table.

[1 mark]

0 2 . 4 The word equation for the reaction is:

metal carbonate $\rightarrow$ metal oxide + carbon dioxide

No atoms are lost or made during a chemical reaction.

Determine the mass of carbon dioxide produced during the thermal decomposition of 2.5 g of calcium carbonate.

Use **Table 1**.

[1 mark]

Mass of carbon dioxide = _____ g

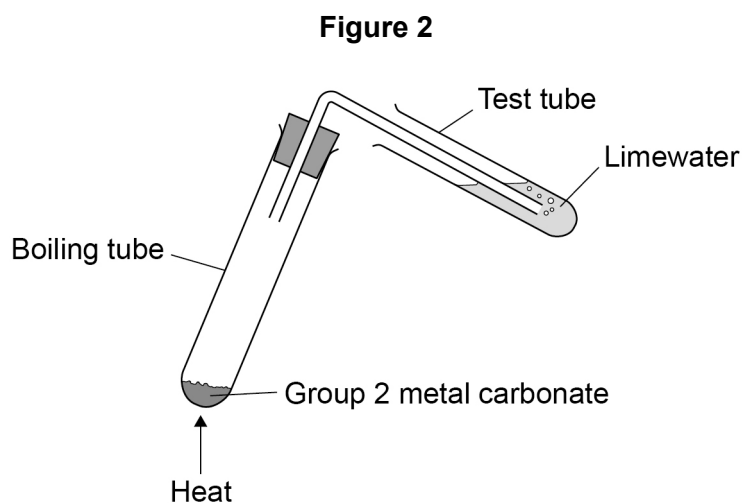
Question 2 continues on the next page

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The student investigated the thermal decomposition of Group 2 metal carbonates using a different method.

Figure 2 shows the apparatus.



0 2 . 5 The test tube in **Figure 2** contains limewater.

Name the compound that is dissolved in water to produce limewater.

[1 mark]

0 2 . 6 Describe the change in the appearance of the limewater during the experiment.

[2 marks]

From _____ to _____



0 2 . 7

Describe how the student could use the apparatus in **Figure 2** to compare how easily each metal carbonate decomposes when heated.

Include any measurements the student should take.

[4 marks]

12

Turn over for the next question

Turn over ►



0 3

This question is about acids, bases and salts.

0 3 . 1

Acids react with bases to produce salts.

What is the name of this type of reaction?

[1 mark]

0 3 . 2Magnesium hydroxide reacts with hydrochloric acid to produce salt **A**.Give the name of salt **A**.**[1 mark]**

0 3 . 3Copper(II) hydroxide reacts with acid **B** to produce copper(II) sulfate.Give the name of acid **B**.**[1 mark]**

0 3 . 4The symbol for a hydroxide ion is OH^-

What is the formula of copper(II) hydroxide?

[1 mark]Tick (✓) **one** box.

CuOH

☐Cu₂OH☐Cu(OH)₂☐Cu₂(OH)₂☐

0 3 . 5 Copper hydroxide is a base but **not** an alkali.

Suggest why copper hydroxide is **not** an alkali.

[1 mark]

0 3 . 6 Hydrochloric acid reacts with sodium hydroxide solution to produce sodium chloride.

Complete the ionic equation for this reaction.

[1 mark]



Question 3 continues on the next page

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A student did a titration.

- burette and stand
- 25.0 cm³ pipette and pipette filler
- conical flask.

- hydrochloric acid
- sodium hydroxide solution
- indicator solution.

[6 marks]

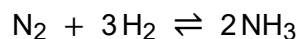
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0 4

This question is about ammonia.

Ammonia is produced when nitrogen gas reacts with hydrogen gas.

The equation for the reaction is:



0 4 . 1

Suggest why the mass of ammonia produced in the reaction is less than the maximum calculated mass.

[1 mark]

0 4 . 2

Iron is added to the reaction mixture to change the rate of reaction.

Iron is **not** used up during the reaction.

What is the effect of iron on the activation energy **and** on the overall energy change?

[1 mark]

Tick (✓) **one** box.

Activation energy	Overall energy change	
Decreases	Decreases	☐
Decreases	No change	☐
Increases	Decreases	☐
Increases	No change	☐

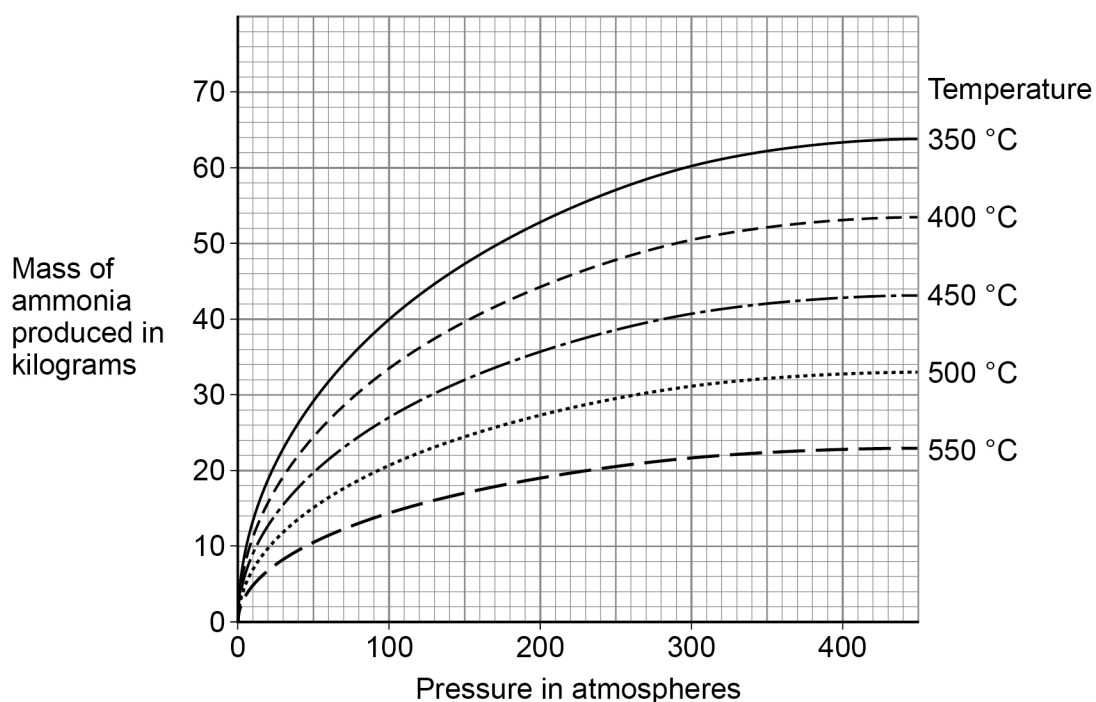
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Figure 3 shows the effect of temperature and the effect of pressure on the mass of ammonia produced.

Figure 3



- 0 4 . 3** Determine the mass of ammonia produced using a pressure of 200 atmospheres and a temperature of 450 °C.

Use **Figure 3**.

[1 mark]

Mass of ammonia produced = _____ kg

- 0 4 . 4** Describe the effect of an increase in temperature on the rate of reaction.

[1 mark]



0 4 . 5 Describe the effect of an increase in temperature on the mass of ammonia produced.

Use **Figure 3**.

[1 mark]

0 4 . 6 Explain the effect of changing the pressure on the rate of the reaction.

[3 marks]

Question 4 continues on the next page

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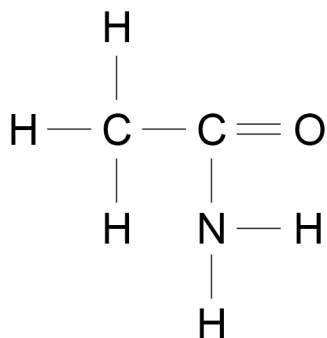


0 4 . 7

Ammonia reacts with ethanoic acid (CH_3COOH) to produce two compounds.

Figure 4 shows the displayed structure of one compound produced when ammonia reacts with ethanoic acid.

Figure 4



Name the other compound produced when ammonia reacts with ethanoic acid.

Use **Figure 4**.

[1 mark]



0 4 . 8

Table 2 gives the composition by mass of an organic compound produced from ammonia.

Table 2

Element	Mass in grams
Carbon	1.5
Hydrogen	0.5
Nitrogen	3.5
Oxygen	2.0

Calculate the empirical formula of the organic compound.

Relative atomic masses (A_r): C = 12 H = 1 N = 14 O = 16

[4 marks]

Empirical formula = _____

13

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0 5

This question is about bonding and structure.

0 5 . 1

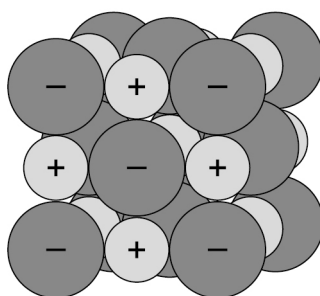
Describe the bonding in a metal.

[3 marks]

A compound is produced when the least reactive alkali metal reacts with the most reactive halogen.

Figure 5 represents the structure of the compound produced.

Figure 5



0 5 . 2

Name the compound produced when the least reactive alkali metal reacts with the most reactive halogen.

Use the periodic table.

[1 mark]



0 5 . 3

Name the type of structure represented in **Figure 5**.

[1 mark]

0 5 . 4

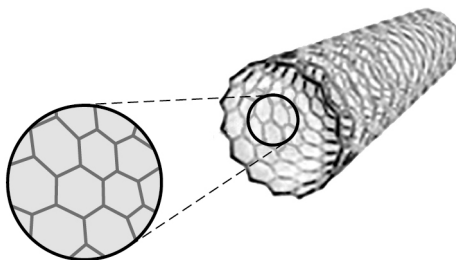
Describe the bonding in the structure represented in **Figure 5**.

[2 marks]

Question 5 continues on the next page**Turn over ►**

Figure 6 represents the structure of a fullerene.

Figure 6



0 5 . 5 Give **one** use of fullerenes.

[1 mark]

0 5 . 6 Calculate the mass of a fullerene containing 3010 carbon atoms.

Avogadro's constant = 6.02×10^{23} atoms per mole

Relative atomic mass (A_r): C = 12

[4 marks]

Mass = _____ g



0 5 . 7

Describe the arrangement of carbon atoms in the fullerene shown in **Figure 6**.**[1 mark]**

0 5 . 8

Explain why a fullerene can conduct electricity.

Refer to the bonding between carbon atoms.

Use **Figure 6**.**[3 marks]**

16

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0 6

This question is about pure substances and mixtures.

0 6 . 1

A scientist dissolved a food colouring in water to make 25.0 cm^3 of solution.

The concentration of the solution was 150 g/dm^3 .

Calculate the mass of food colouring needed to make the solution.

[3 marks]

Mass of food colouring = _____ g

0 6 . 2

The scientist used paper chromatography to analyse a food colouring.

How would the results of a chromatography experiment show that the food colouring is a pure substance?

[1 mark]

0 6 . 3

Describe how the results of a chromatography experiment can be used to identify a food colouring.

[2 marks]

0 6 . 4

Name a method used to separate a mixture of liquids with different boiling points.

[1 mark]



0 6 . 5

A student investigated the composition of a mixture.

The mixture was produced by mixing together **two** different solid ionic compounds.

The student dissolved the mixture in water and did four tests on the solution produced.

Table 3 gives a description of the tests and the results of the tests.

Table 3

Test	Result
Flame test	Yellow flame colour
Addition of sodium hydroxide solution	Blue precipitate
Addition of barium chloride solution	White precipitate
Addition of silver nitrate solution	White precipitate

One of the compounds used to make the mixture:

- is coloured
- contains three different elements.

Which **two** ionic compounds were used to produce the mixture?

Explain your reasoning.

[4 marks]



0	7
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This question is about copper and aluminium.

0	7	.	1
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Copper has properties that are useful for plumbing.

Give **one** property that makes copper useful for plumbing.

[1 mark]

0	7	.	2
---	---	---	---

Copper can be obtained from solutions of copper salts.

Describe a method to obtain copper from a solution of a copper salt by displacement.

[2 marks]



Aluminium is extracted from aluminium oxide by electrolysis.

0 7 . 3 Calculate the percentage (%) by mass of aluminium in aluminium oxide (Al_2O_3).

Give your answer to 2 significant figures.

Relative atomic masses (A_r): Al = 27 O = 16

[4 marks]

Percentage by mass (2 significant figures) = _____ %

0 7 . 4 Aluminium is extracted by the electrolysis of a molten mixture of aluminium oxide and cryolite.

Explain why the process would be more expensive if the electrolyte was pure aluminium oxide.

[2 marks]

0 7 . 5 Write the half equation for the reaction that occurs at the negative electrode during the electrolysis of aluminium oxide.

[2 marks]

_____ + _____ $\longrightarrow$ _____

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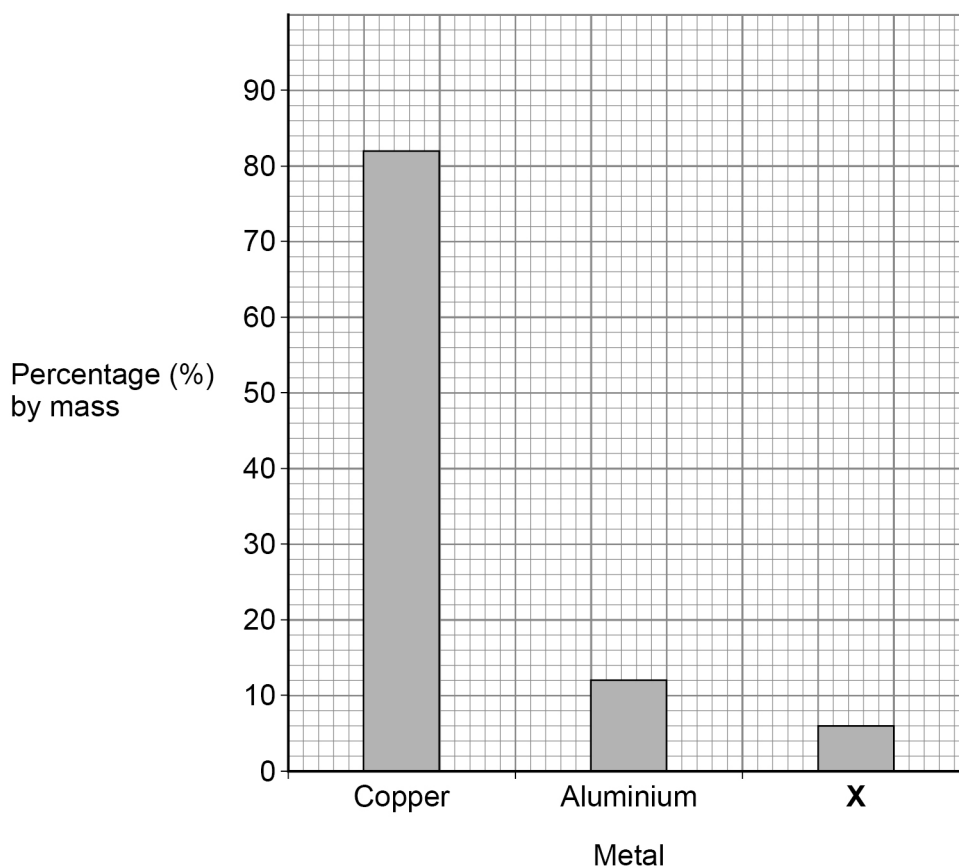


Metals can be mixed together to produce alloys.

An alloy is produced by mixing copper with aluminium and one other metal (**X**).

Figure 7 shows the percentage (%) by mass of the three metals used to produce the alloy.

Figure 7



07.6

There are 0.075 moles of **X** in 70 g of the alloy.

Determine the relative atomic mass (A_r) of **X**.

Use **Figure 7**.

[4 marks]

Relative atomic mass (A_r) of **X** = _____

07.7

Name metal **X**.

Use the periodic table and your answer to Question **07.6**

[1 mark]

07.8

An alloy produced by mixing copper with a small quantity of other metals is better for making machinery than pure copper.

Suggest **one** reason why.

[1 mark]

Turn over for the next question

17

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0	8
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This question is about silicon.

Silicon tetrafluoride (SiF_4) can be produced when silicon reacts with fluorine.

0	8	.	1
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Write the balanced equation for the reaction between silicon and fluorine to produce silicon tetrafluoride.

[2 marks]



0	8	.	2
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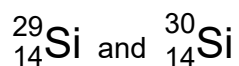
Explain why silicon tetrafluoride has a low boiling point.

[3 marks]



Two of the isotopes of the element silicon are silicon-29 and silicon-30

The isotopes can be represented as:



0 8 . 3

Explain why molecules of silicon tetrafluoride containing different silicon isotopes diffuse at different rates.

[2 marks]

0 8 . 4

An accurate value for the relative atomic mass (A_r) of silicon is 28.09

Suggest which isotopes make up a sample of pure silicon.

You should refer to the proportion of each isotope in the sample.

[3 marks]

10

END OF QUESTIONS



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