

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

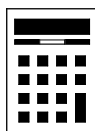
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Monday 4 November 2024 07:00 GMT Time allowed: 1 hour 45 minutes

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	
5	
6	
7	
8	
9	
10	
TOTAL	



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

0 1

This question is about pure substances and mixtures.

A scientist tests the purity of a drug used as a medicine.

0 1 . 1

The scientist measures the melting point of a sample of the drug.

The melting point of the pure drug is 135 °C.

The sample of the drug melts between 129–133 °C.

Give **two** reasons why the data shows that the sample is **not** a pure sample of the drug.

[2 marks]

1 _____

2 _____

0 1 . 2

Suggest why it is important to test the purity of drugs before the drug is used as a medicine.

[1 mark]



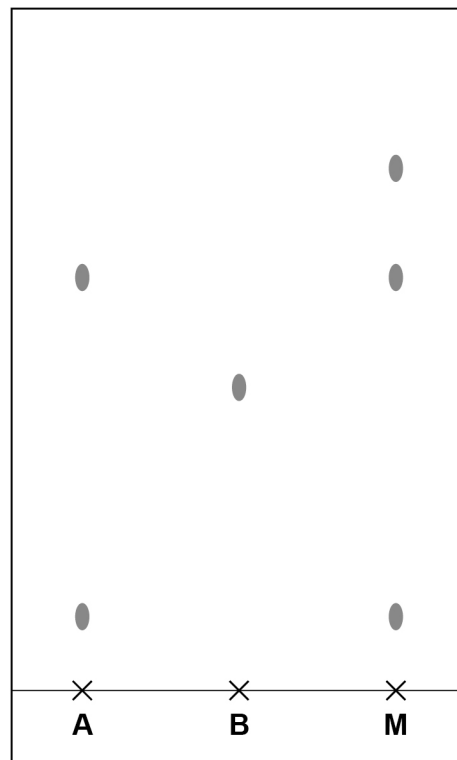
Chromatography is used to analyse mixtures.

0 1 . 3 A student investigated a food colouring **M**.

The student used chromatography to compare food colouring **M** with known colours **A** and **B**.

Figure 1 shows the results.

Figure 1



Give **three** conclusions about food colouring **M**.

[3 marks]

- 1 _____
- 2 _____
- 3 _____

Question 1 continues on the next page

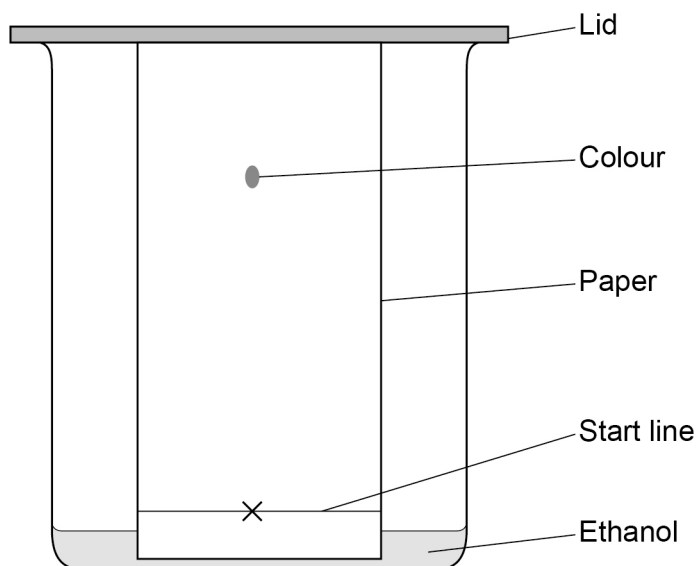
Turn over ►



The student investigated a different food colouring using ethanol as the solvent.

Figure 2 shows the apparatus.

Figure 2



0 1 . 4 Ethanol has a boiling point of 78 °C.

Suggest why the student used a lid when using ethanol as the solvent.

[1 mark]

0 1 . 5 Give **one** reason why the start line is drawn in pencil rather than in ink.

[1 mark]

0 1 . 6 Chromatography involves a mobile phase and a stationary phase.

Draw **one** line from each phase to the correct description of that phase in **Figure 2**.

[2 marks]

Phase	Description of phase
	Colour
	Ethanol
Mobile	Lid
Stationary	Paper
	Start line

10

Turn over for the next question

Turn over ►



0 2

This question is about acids, bases and salts.

0 2 . 1

Sodium hydroxide is an alkali and a base.

Copper oxide is only a base.

Give **one** similarity and **one** difference between an alkali and a base.

[2 marks]

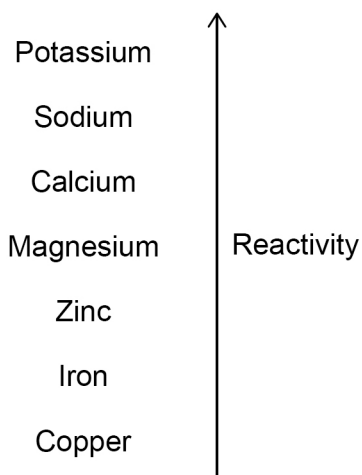
Similarity _____

Difference _____

Some metals can react with dilute acids to make a salt.

Figure 3 shows a reactivity series of metals.

Figure 3

**0 2 . 2**

Give **one** reason why copper **cannot** be used to make a salt using dilute acid.

[1 mark]



[1 mark]

[6 marks]

Question 2 continues on the next page

Turn over ►



0	2	.	5
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58 g is the maximum mass of zinc sulfate that dissolves in 100 g of water.

Calculate the minimum mass of water needed to dissolve 14.5 g of zinc sulfate.

[2 marks]

Minimum mass of water = _____ g

12

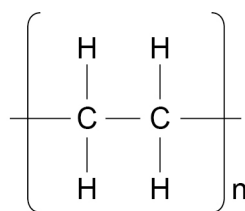


0 3

Nickel can catalyse the decomposition of poly(ethene) waste.

0 3 . 1

The polymer poly(ethene) has the displayed structural formula:

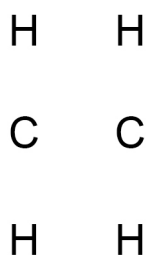


Poly(ethene) is produced from the monomer ethene.

Complete **Figure 4** to show the displayed structural formula of ethene.

[2 marks]

Figure 4



0 3 . 2

Poly(ethene) is a thermosoftening polymer.

Thermosoftening polymers melt when heated.

What type of polymers do **not** melt when heated?

[1 mark]

0 3 . 3

Poly(ethene) is **not** biodegradable.

What is meant by 'biodegradable'?

[1 mark]

Turn over ►



0 3 . 4 Explain how catalysts change the rate of reaction.

You should refer to:

- reaction pathways
- activation energy.

[2 marks]

0 3 . 5 Which is an advantage of using a nickel catalyst to break down poly(ethene)?

[1 mark]

Tick (✓) **one** box.

Less poly(ethene) waste will end up in landfill.

☐

Less poly(ethene) will be used.

☐

The poly(ethene) produced will be stronger.

☐

The poly(ethene) will be produced more quickly.

☐

The nickel used to make the catalyst can be extracted by phytomining.

Phytomining is an alternative to traditional mining.

0 3 . 6 What is used to extract metal compounds in phytomining?

[1 mark]

0 3 . 7 Extraction of nickel by traditional mining has an environmental impact.

Suggest **one** environmental impact of traditional mining.

[1 mark]

9

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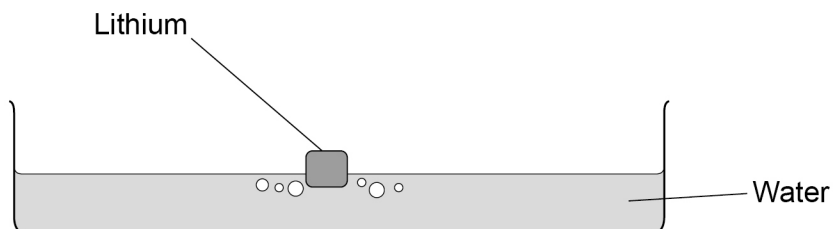
0	4
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This question is about Group 1 elements and Group 0 elements.

Group 1 elements react with water.

Figure 5 shows lithium reacting with water.

Figure 5



0	4	.	1
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Give **two** ways that the observations made would be different from **Figure 5** if rubidium is added to water.

[2 marks]

- 1 _____

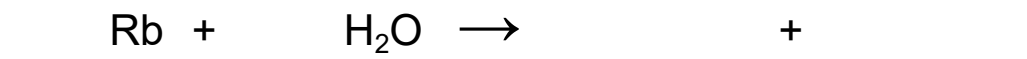
2 _____

0	4	.	2
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Complete the equation for the reaction between rubidium and water.

You should balance the equation.

[3 marks]



0 4 . 3 3.40×10^{-4} moles of rubidium reacted in the first 5 seconds of a reaction.

Calculate the rate of reaction in g/s.

Relative atomic mass (A_r): Rb = 85

[4 marks]

Rate = _____ g/s

0 4 . 4 Rubidium and potassium are in the same group of the periodic table.

Rubidium and potassium have different reactivities.

Explain why.

[4 marks]

Question 4 continues on the next page

Turn over ►



0 4 . 5 The atomic number of krypton is 36 and the atomic number of rubidium is 37.

Krypton and rubidium have very different reactivities.

Explain why krypton is unreactive.

[2 marks]

15



0 5

Copper is used for electrical wiring and water pipes.

PVC is a polymer.

PVC can be used instead of copper for water pipes.

Table 1 shows some properties of copper and PVC.

Table 1

Property	Copper	PVC
Density in g/cm ³	9.0	1.4
Electrical conductivity in arbitrary units	60	1.0×10^{-12}
Melting point in °C	1085	150
Reactivity with water	none	none

0 5 . 1

Give **one** reason why PVC could **not** replace copper as a material for electrical wires.

Use **Table 1**.

[1 mark]

0 5 . 2

Explain **one** advantage of using PVC instead of copper to make water pipes.

Use **Table 1**.

[2 marks]

Question 5 continues on the next page

Turn over ►



0 5 . 3 Explain why copper can be bent into shape.

[2 marks]

0 5 . 4 Describe how copper compounds are extracted from low-grade ores by bioleaching.

[2 marks]

0 5 . 5 Calculate the number of atoms in 88.9 g of copper.

Give your answer to 3 significant figures.

Relative atomic mass (A_r): Cu = 63.5

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

[4 marks]

Number of atoms (3 significant figures) = _____

11



0 6

This question is about thermal decomposition reactions.

A student heated four different Group 1 carbonates.

This is the method used.

- 1 Add 5.0 g of lithium carbonate to a crucible.
- 2 Measure the mass of the crucible and contents.
- 3 Heat the crucible and contents for 5 minutes.
- 4 Allow to cool.
- 5 Measure the mass of the crucible and contents again.
- 6 Repeat steps 1 to 5 using different carbonates.

Table 2 shows the results.

Table 2

Name of carbonate	Mass of crucible and contents at start in grams	Mass of crucible and contents after heating for 5 minutes in grams	Change in mass in grams
Lithium carbonate	25.0	22.0	3.0
Sodium carbonate	25.0	25.0	0.0
Potassium carbonate	25.0	25.0	0.0
Rubidium carbonate	25.0	25.0	0.0

0 6 . 1

The student concluded that Group 1 metal carbonates do **not** decompose.

Evaluate the student's conclusion.

Use **Table 2**.

[2 marks]

Turn over ►



0	6	.	2
---	---	---	---

Thermal decomposition reactions are endothermic.

Explain why.

You should refer to bonds broken and bonds formed in your answer.

[3 marks]

0	6	.	3
---	---	---	---

Magnesium carbonate decomposes on heating.

The equation for the reaction is:



Calculate the mass of carbon dioxide produced from 4.2 g of magnesium carbonate.

Relative formula masses (M_r): $\text{MgCO}_3 = 84$ $\text{CO}_2 = 44$

[3 marks]

Mass of carbon dioxide = _____ g



0	6	.	4
---	---	---	---

Magnesium nitrate can also decompose on heating.

The equation for the reaction is:



0.1 mol of magnesium nitrate is decomposed.

Determine the total number of moles of gas produced.

[1 mark]

Total moles of gas = _____ mol

9

Turn over for the next question

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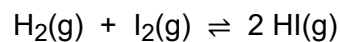


0 7

This question is about hydrogen halides.

Hydrogen iodide is produced by reacting hydrogen with iodine.

The equation for the reaction is:

**0 7 . 1**

For the forward reaction $\Delta H = -9 \text{ kJ/mol}$.

Determine ΔH for the reverse reaction.

[1 mark]

_____ kJ/mol

0 7 . 2

A student calculated the maximum mass of the hydrogen iodide that should be formed.

Give **one** reason why less than the calculated mass was obtained.

[1 mark]

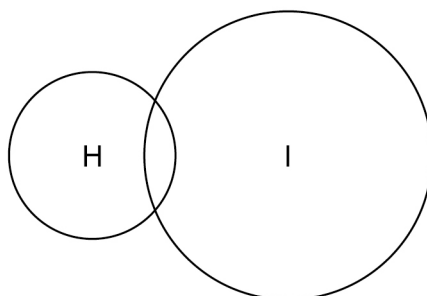
0 7 . 3

Explain the effect of increasing the pressure of hydrogen gas on the rate of reaction.

[2 marks]



0 7 . 4

Complete **Figure 6** to show the outer shell electrons in a molecule of hydrogen iodide.**[2 marks]****Figure 6**

0 7 . 5

Hydrogen reacts with chlorine to produce hydrogen chloride.

Figure 7 shows the displayed structures of the reactants and the product.**Figure 7****Table 3** shows the bond energies.**Table 3**

Bond	H-H	Cl-Cl	H-Cl
Energy in kJ/mol	436	243	432

Calculate the energy change of the reaction.

[3 marks]

Energy change = _____ kJ/mol

9

Turn over ►

0 8

Table 4 shows some properties of three substances **E**, **F** and **G**.

Table 4

Substance	Melting point in °C	Electrical conductivity when solid	Electrical conductivity when liquid	Hardness in arbitrary units
E	801	Poor	Good	2
F	4000	Poor	Poor	10
G	50	Poor	Poor	0.5

0 8

1

Explain why substance **E** has a high melting point.

You should answer in terms of structure and bonding.

Use **Table 4**.

[4 marks]



0 8 . 2 Explain why substance **F** is very hard.

You should answer in terms of structure and bonding.

Use **Table 4**.

[2 marks]

0 8 . 3 Explain why substance **G** does **not** conduct electricity.

You should answer in terms of structure.

Use **Table 4**.

[2 marks]

8

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0 9

This question is about the electrolysis of sodium chloride solution.

The products of the electrolysis are chlorine, hydrogen and sodium hydroxide.

0 9 . 1

Give **one** use for chlorine and **one** use for sodium hydroxide.

[2 marks]

Chlorine _____

Sodium hydroxide _____

0 9 . 2

The relative atomic mass of chlorine is 35.5

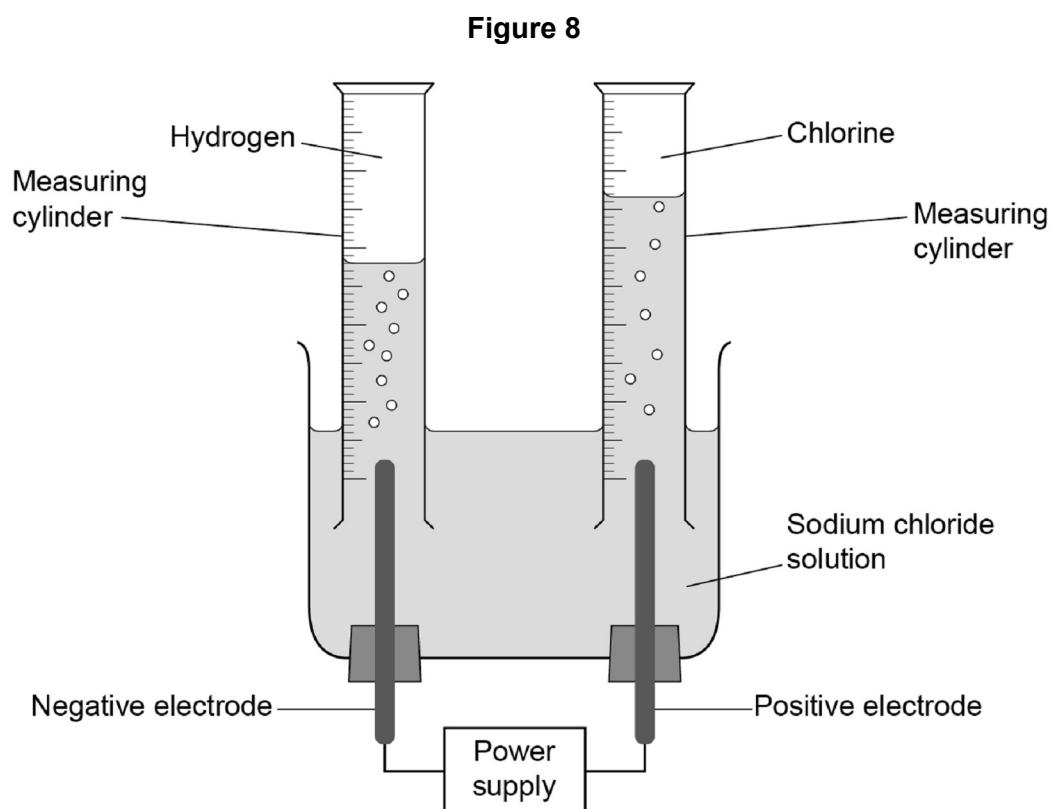
Explain why the relative atomic mass of chlorine is not a whole number.

[2 marks]

Question 9 continues on the next page

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Figure 8 shows the electrolysis of sodium chloride solution.



- 0 9 . 3** Give the reason why hydrogen is formed at the negative electrode rather than sodium. **[1 mark]**

- 0 9 . 4** Complete the half equation for the formation of hydrogen at the negative electrode. **[2 marks]**

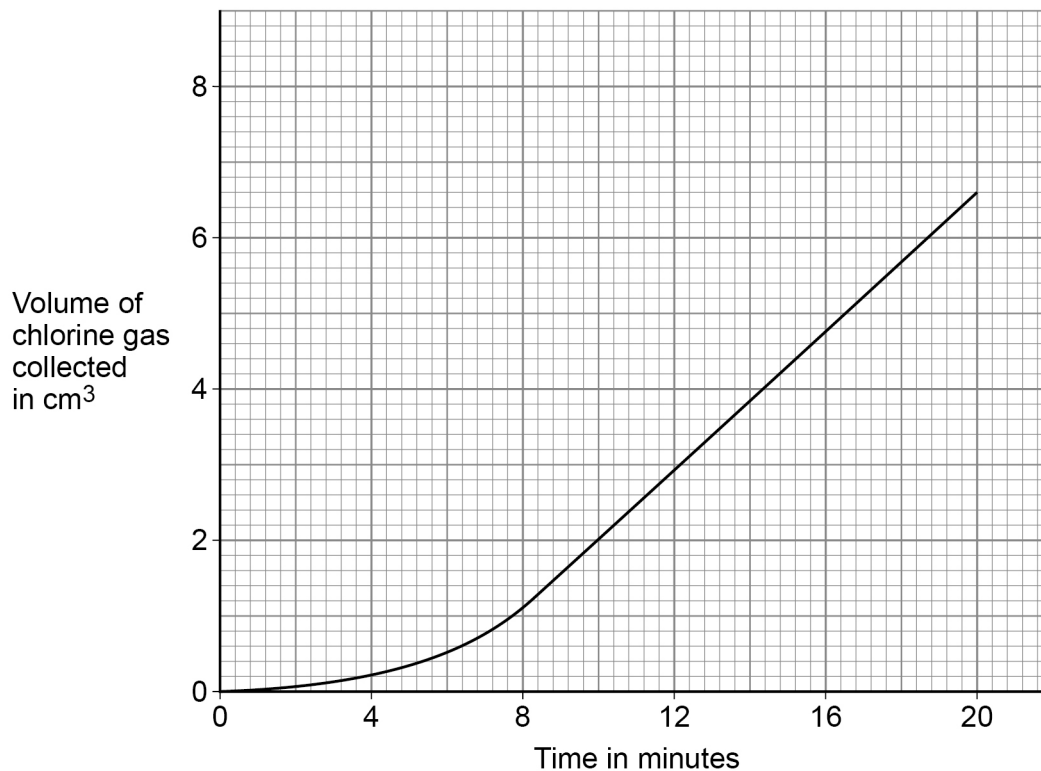


0 9 . 5

The volume of chlorine gas collected was measured at regular intervals for 20 minutes.

Figure 9 shows the results.

Figure 9



The trend for the first 8 minutes is different to the trend after 8 minutes.

Suggest **one** reason for the difference in trends.

[1 mark]

0 9 . 6

A solution of sodium chloride of very low concentration was electrolysed.

Oxygen was produced rather than chlorine at the positive electrode.

Suggest which ion is losing electrons to produce oxygen gas.

[1 mark]

9



1 0

This question is about acids.

Table 5 gives information about some acids.**Table 5**

Name	Formula	pH of 0.1 mol/dm ³ solution of acid
Nitric acid	HNO ₃	1.00
Ethanoic acid	CH ₃ COOH	2.80
Propanoic acid	CH ₃ CH ₂ COOH	2.94
Butanoic acid	CH ₃ CH ₂ CH ₂ COOH	2.91

1 0 . 1

Explain why the carboxylic acids in **Table 5** have a different pH to nitric acid.**[2 marks]**

1 0 . 2

Complete the general formula for the homologous series of carboxylic acids.

Use **Table 5**.**[1 mark]**C _____ H _____ O₂

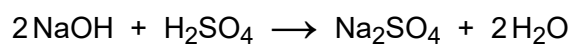
1 0 . 3

Complete **Figure 10** to show the displayed structure of propanoic acid.**[1 mark]****Figure 10**

1 0 . 4

25.0 cm³ of 0.110 mol/dm³ sodium hydroxide solution is neutralised by 27.5 cm³ of sulfuric acid.

The equation for the reaction is:



Calculate the concentration of the sulfuric acid.

[4 marks]

Concentration = _____ mol/dm³

8

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