

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

E

Tuesday 28 May 2024

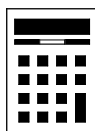
07:00 GMT

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	
TOTAL	



J U N 2 4 9 2 0 4 C E 0 1

IB/G/Jun24/G4001/E8

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

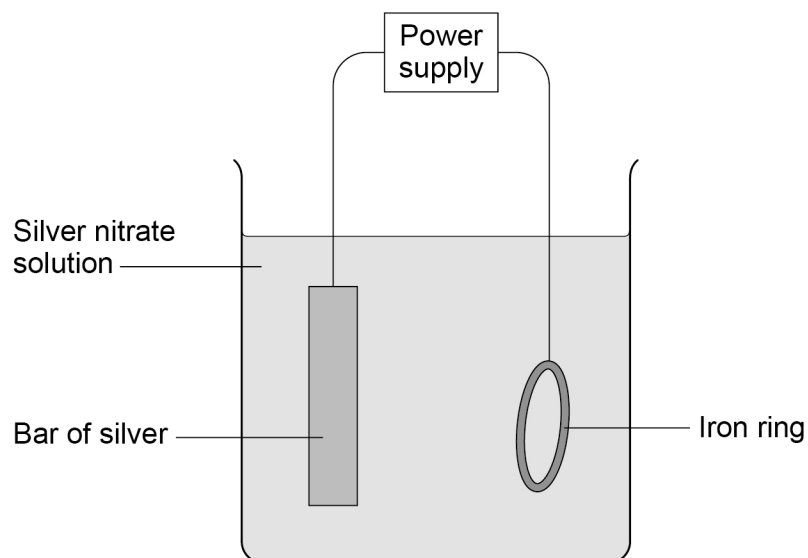
0 1

This question is about electroplating and electrolysis.

An iron ring was electroplated with silver.

Figure 1 shows the apparatus.

Figure 1



0 1 . 1

Give **two** reasons why objects are electroplated.

[2 marks]

1 _____

2 _____

0 1 . 2

A solution of silver nitrate is used for the electroplating.

Give the reason why solid silver nitrate does **not** conduct electricity.

You should refer to ions in your answer.

[1 mark]



0 1 . 3

Silver is deposited on the iron ring at a rate of 1.1 g per hour.

Calculate the time needed for the iron ring to increase in mass by 0.33 g.

Give your answer in minutes.

[3 marks]

Time needed = _____ minutes

A teacher electrolysed a solution of zinc bromide.

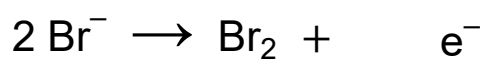
Hydrogen and bromine were produced.

0 1 . 4

Bromine was produced at the positive electrode.

Balance the equation for the reaction at the positive electrode.

[1 mark]



0 1 . 5

Hydrogen was produced at the negative electrode.

What can be concluded about the reactivity of zinc compared with the reactivity of hydrogen?

[1 mark]

Turn over ►



0	2
---	---

This question is about chlorine and compounds of chlorine.

0	2	.	1
---	---	---	---

An atom of chlorine is represented as $^{35}_{17}\text{Cl}$

What is the electronic structure of this chlorine atom?

[1 mark]

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

Chlorine has similar chemical properties to other elements in the same group of the periodic table.

Give **one** reason why.

[1 mark]

0	2	.	3
---	---	---	---

Which noble gas has the same electron arrangement as a chloride ion (Cl^-)?

Use the periodic table.

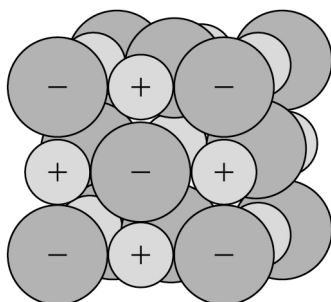
[1 mark]



0 2 . 4

Figure 2 represents the structure of sodium chloride.

Figure 2



Describe the structure and bonding in sodium chloride.

[3 marks]

0 2 . 5

The formula of magnesium chloride is MgCl_2

Calculate the percentage by mass of chlorine in magnesium chloride.

Give your answer to 3 significant figures.

Relative atomic mass (A_r): Cl = 35.5Relative formula mass (M_r): MgCl_2 = 95**[3 marks]**

Percentage by mass of chlorine (3 significant figures) = _____ %

9

Turn over ►



0 3

A student investigated the reaction between magnesium and hydrochloric acid.

The reaction produced magnesium chloride and hydrogen gas.

0 3 . 1

The student added 0.003 moles of magnesium to hydrochloric acid.

Calculate the mass of magnesium used.

Relative atomic mass (A_r): Mg = 24

[2 marks]

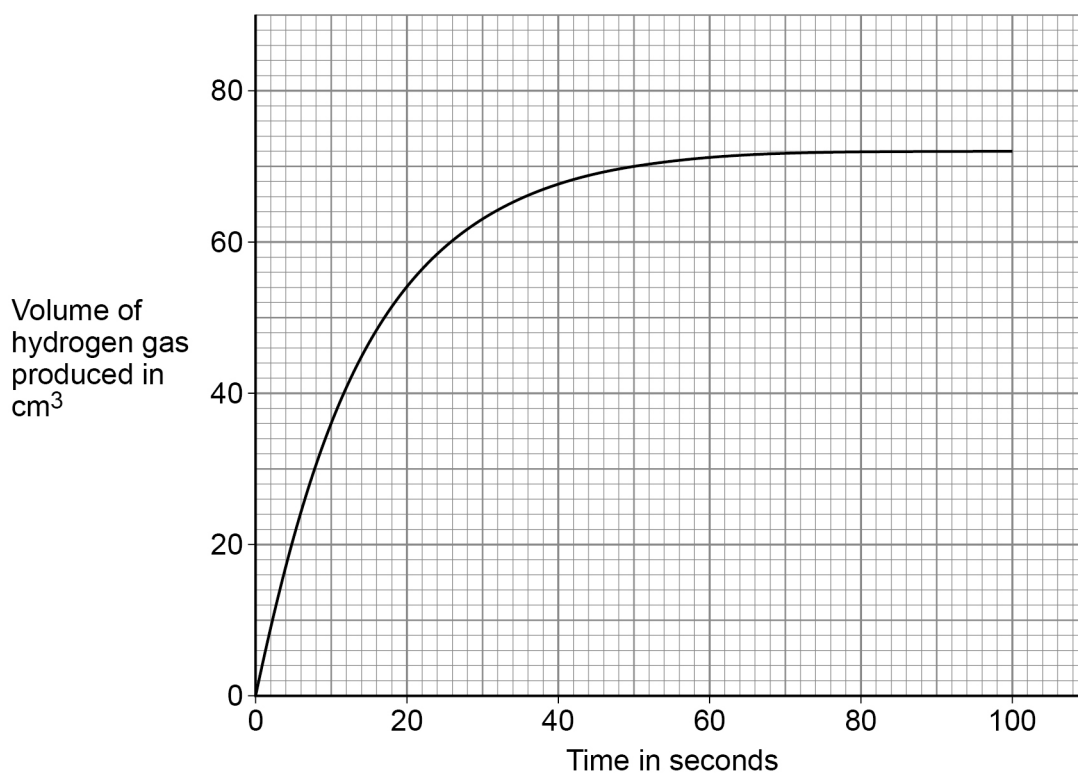
Mass = _____ g



0 3 . 2 The student measured the volume of hydrogen gas produced over time.

Figure 3 shows the results.

Figure 3



Determine the mean rate of reaction between 10 seconds and 50 seconds.

Use **Figure 3** and the equation:

$$\text{Rate of reaction} = \frac{\text{volume of hydrogen gas}}{\text{time taken}}$$

[4 marks]

Rate of reaction = _____ cm³/s

Turn over ►



[6 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[2 marks]

0	4
---	---

This question is about ammonia.

0	4	.	1
---	---	---	---

Ammonia molecules are made of atoms.

Explain why the mass of an atom is concentrated in the centre of the atom.

You should refer to protons, neutrons and electrons in your answer.

[4 marks]

Question 4 continues on the next page

Turn over ►



0 4 . 2

Ammonia dissolves in water to produce an alkaline solution.

Give the formula of the ion that all alkaline solutions contain.

[1 mark]

0 4 . 3

Ammonia reacts with sulfuric acid to produce ammonium sulfate.

Ammonium sulfate contains the ions:

- NH_4^+
- SO_4^{2-}

What is the formula of ammonium sulfate?

[1 mark]

Tick (✓) **one** box.

NH_4SO_4

☐

$\text{NH}_4(\text{SO}_4)_2$

☐

$(\text{NH}_4)_2\text{SO}_4$

☐

NH_8SO_4

☐

0 4 . 4

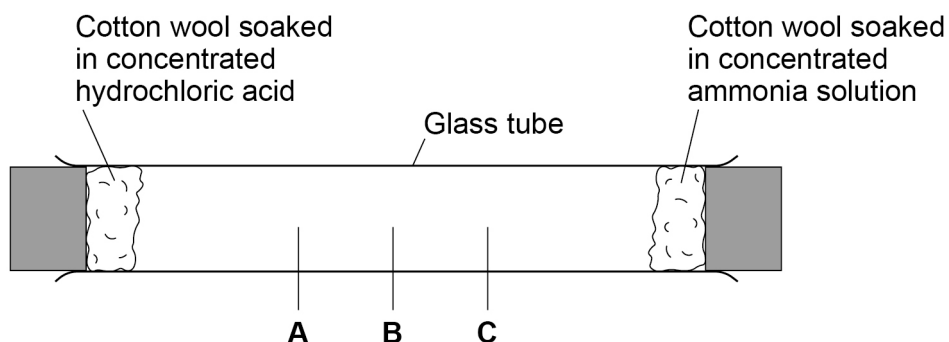
A teacher demonstrated the movement of gas molecules along a tube.

The teacher used:

- concentrated hydrochloric acid that gives off hydrogen chloride gas
- concentrated ammonia solution that gives off ammonia gas.

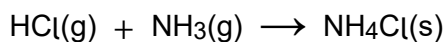
Figure 4 shows the apparatus used.

Figure 4



Hydrogen chloride gas and ammonia gas react to produce ammonium chloride, a white solid.

The equation for the reaction is:



Where will the white solid form in the tube?

Explain your answer.

Relative formula masses (M_r): $\text{NH}_3 = 17$ $\text{HCl} = 36.5$

[4 marks]

Tick (✓) **one** box.

A

☐

B

☐

C

☐

Explanation _____

10

Turn over ►



0 5

Poly(ethene) is produced from ethene.

Low-density poly(ethene) (LDPE) and high-density poly(ethene) (HDPE) are polymers made from ethene molecules.

0 5**1**

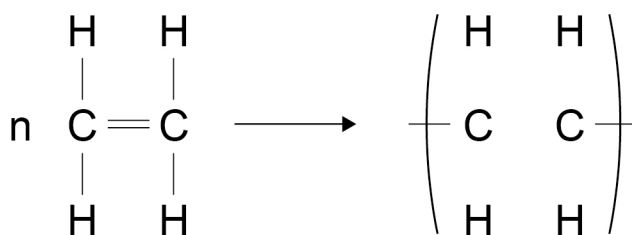
Describe a test for ethene.

Give the result of the test.

[2 marks]

Test _____

Result _____

0 5**2****Figure 5** shows part of the displayed structures for the reaction to form poly(ethene).Complete **Figure 5**.**[2 marks]****Figure 5**

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0	5	.	3	LDPE and HDPE are both produced from ethene.
---	---	---	---	--

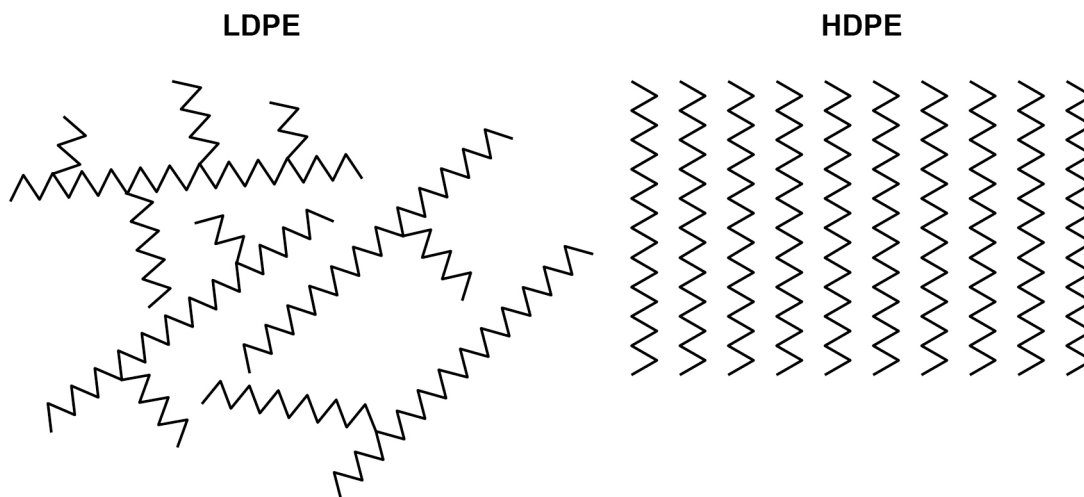
How can two different polymers be produced from ethene molecules?

[1 mark]

0	5	.	4	LPDE and HDPE are thermosoftening polymers.
---	---	---	---	---

Figure 6 represents the polymer chains of LDPE and HDPE.

Figure 6



Suggest **one** reason why LDPE has a lower melting point than HDPE.

[1 mark]

Question 5 continues on the next page

Turn over ►



0	5	.	5
---	---	---	---

Table 1

	Polymer	
	Poly(ethene)	PLA
Raw material	Crude oil	Cornstarch
Source of raw material	Underground oil well	Corn plants grown in cleared forest
Biodegradability	Does not decompose	Decomposes in 120 days in industrial composters

Evaluate the environmental impact of using poly(ethene) and PLA.

[4 marks]

[illegible]

10



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0 6

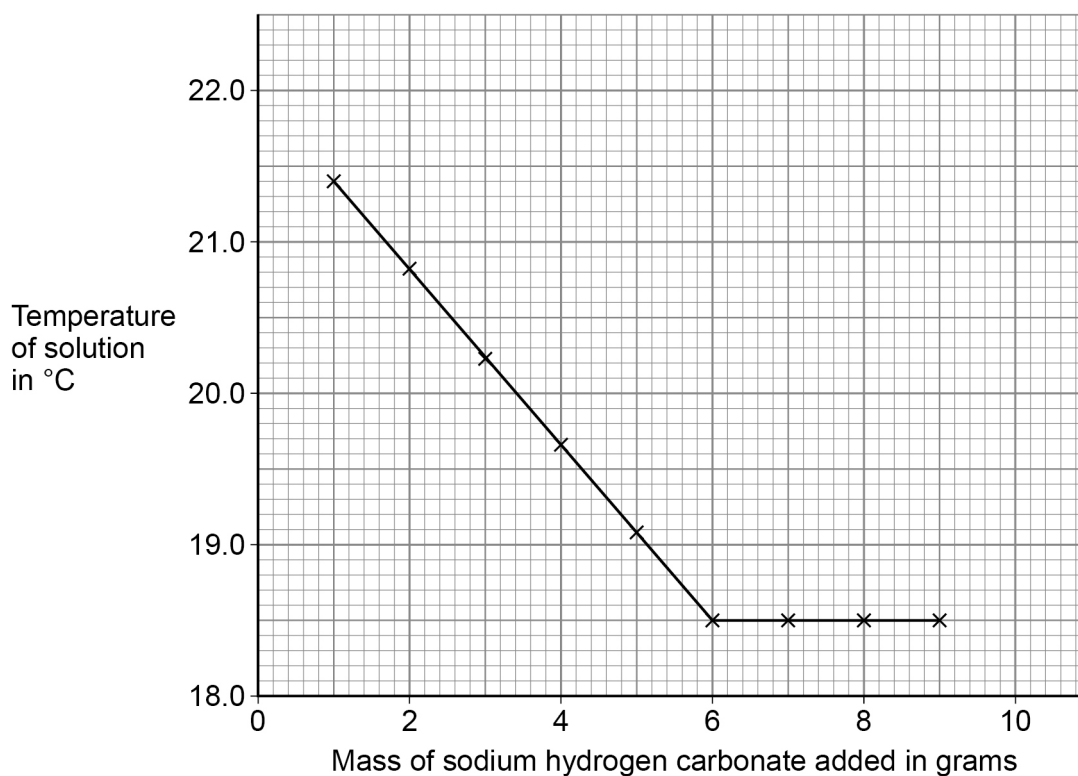
A student investigated the energy change of the reaction between hydrochloric acid and sodium hydrogen carbonate.

This is the method used.

1. Measure 50 cm³ of hydrochloric acid into a plastic cup.
2. Measure the starting temperature of the hydrochloric acid.
3. Add 1 g of sodium hydrogen carbonate powder to the plastic cup.
4. Stir the solution.
5. Measure the temperature of the solution.
6. Repeat steps 3 to 5 until a total of 9 g of sodium hydrogen carbonate has been added.

Figure 7 shows the results.

Figure 7



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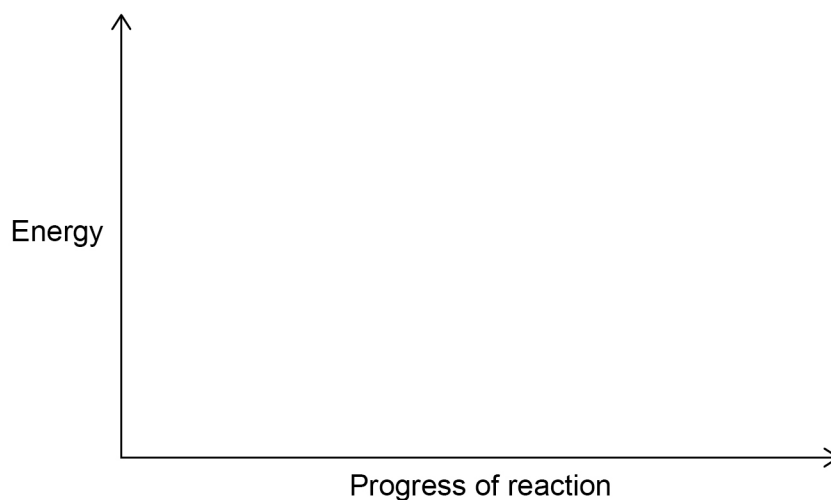
0 6 . 1 Explain the trends shown by the results.

Use data from **Figure 7**.

[4 marks]

0 6 . 2 **Figure 8** shows part of an energy level diagram for the reaction between hydrochloric acid and sodium hydrogen carbonate.

Figure 8



Complete **Figure 8**.

Use **Figure 7**.

You should:

- label the reactants and products
- label the activation energy
- label the overall energy change.

[4 marks]

Turn over ►



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

The reaction between sodium hydrogen carbonate and hydrochloric acid produces carbon dioxide.

When carbon dioxide is bubbled through calcium hydroxide solution, the solution turns cloudy white.

Explain why the solution turns cloudy white.

[2 marks]

10

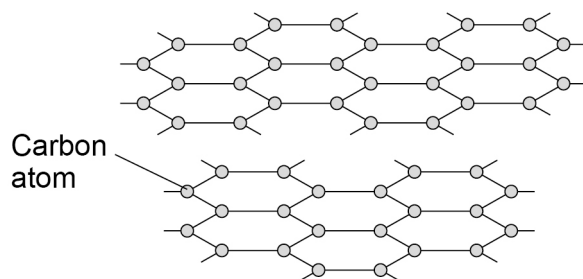


07

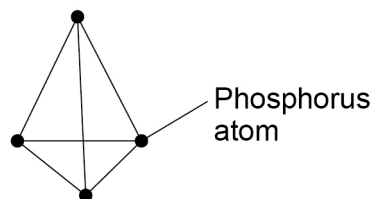
This question is about the bonding and reactions of some elements.

Figure 9 represents the arrangement of atoms in two non-metal elements.

Figure 9



Graphite



Phosphorus

07.1

Compare the bonding and structure of graphite and phosphorus.

[4 marks]

07.2

Explain why graphite conducts electricity.

[2 marks]

Question 7 continues on the next page

Turn over ►



0 7 . 3 Phosphorus reacts with oxygen to form an oxide.

A sample of the oxide contains 3.1 g of phosphorus and 4.0 g of oxygen.

Calculate the empirical formula of this oxide of phosphorus.

Relative atomic masses (A_r): P = 31 O = 16

[4 marks]

Empirical formula = _____

0 7 . 4 A student investigated four metals **A**, **B**, **C** and **D**.

Metal **D** is the only one that reacted with cold water.

Metal **C** reacted more vigorously than metal **B** with dilute acid.

Metal **A** displaced metal **C** from its compound.

Write down the metals in order of reactivity.

[1 mark]

Most reactive _____

Least reactive _____



0	7	.	5
---	---	---	---

Lithium and potassium are in Group 1 of the periodic table.

Lithium and potassium have a different reactivity with water.

Explain the difference in reactivity.

[4 marks]

15

Turn over for the next question

Turn over ►



0 8

This question is about substances found in crude oil.

0 8**. 1**

Explain how crude oil is separated into fractions by fractional distillation.

[4 marks]

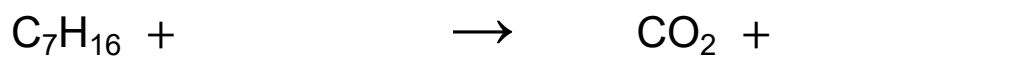
Heptane (C_7H_{16}) is a compound found in crude oil.

Heptane is used as a fuel.

0 8**. 2**Heptane combusts in oxygen (O_2) to produce carbon dioxide and water.

Complete the equation for the combustion of heptane.

Balance the equation.

[2 marks]**0 8****. 3**

The carbon and hydrogen in heptane are oxidised during combustion.

What does 'oxidised' mean?

[1 mark]



0	8	.	4
---	---	---	---

A different alkane **X** undergoes complete combustion.

0.1 mol of alkane **X** produces 17.6 g of carbon dioxide when combusted.

Determine the formula of alkane **X**.

You should calculate the number of moles of carbon atoms in alkane **X**.

Relative atomic masses (A_r): C = 12 O = 16

[4 marks]

Number of moles of carbon atoms =

Formula

11

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0 9

This question is about analysing ions and precipitates.

0 9 . 1

A student tested solutions of two ionic compounds **A** and **B**.

Table 2 shows the results.

Table 2

Test	Observation with compound A	Observation with compound B
Add sodium hydroxide solution	White precipitate forms	Brown precipitate forms
Add dilute nitric acid followed by silver nitrate solution	Cream precipitate forms	Yellow precipitate forms

A flame test was then done on compound **A**.

A red flame colour was seen.

Determine the name of compound **A** and the name of compound **B**.

[4 marks]

Compound **A** _____

Compound **B** _____

Question 9 continues on the next page

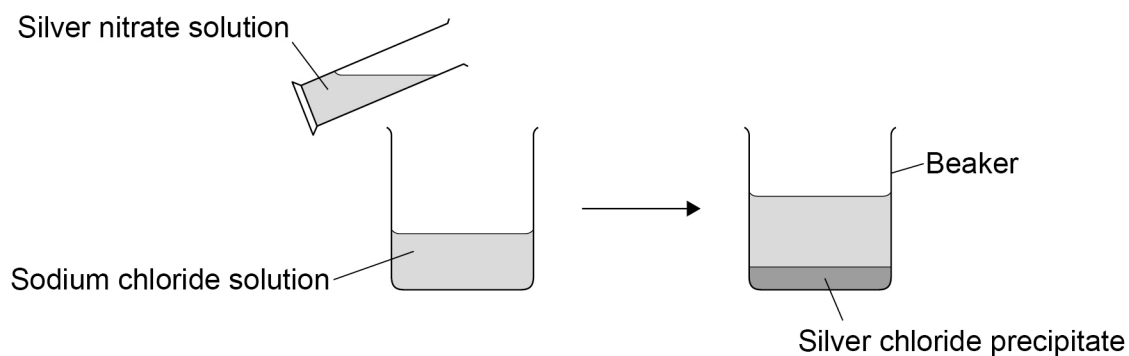
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A student reacted silver nitrate solution with sodium chloride solution. A precipitate of silver chloride was produced.

Figure 10 shows the apparatus.

Figure 10



0 9 . 2

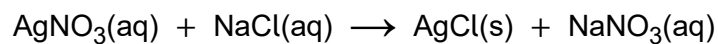
Describe a method to find the mass of the silver chloride precipitate produced.

[4 marks]



0	9	.	3
---	---	---	---

The equation for the reaction between silver nitrate and sodium chloride is:



15 cm³ of 0.40 mol/dm³ sodium chloride solution was added to a solution of silver nitrate.

Calculate the maximum mass of silver chloride produced.

Relative formula mass (M_r): AgCl = 143.5

[5 marks]

Mass of silver chloride = _____ g

13

END OF QUESTIONS



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Question number	Additional page, if required. Write the question numbers in the left-hand margin.



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