Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
June 2015

Additional Science
Unit Chemistry C2

CH2HP

H

Chemistry
Unit Chemistry C2

Thursday 14 May 2015 9.00 am to 10.00 am

For this paper you must have:
- a ruler
- the Chemistry Data Sheet (enclosed).

You may use a calculator.

A

Time allowed
- 1 hour

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.
- 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 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(c) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

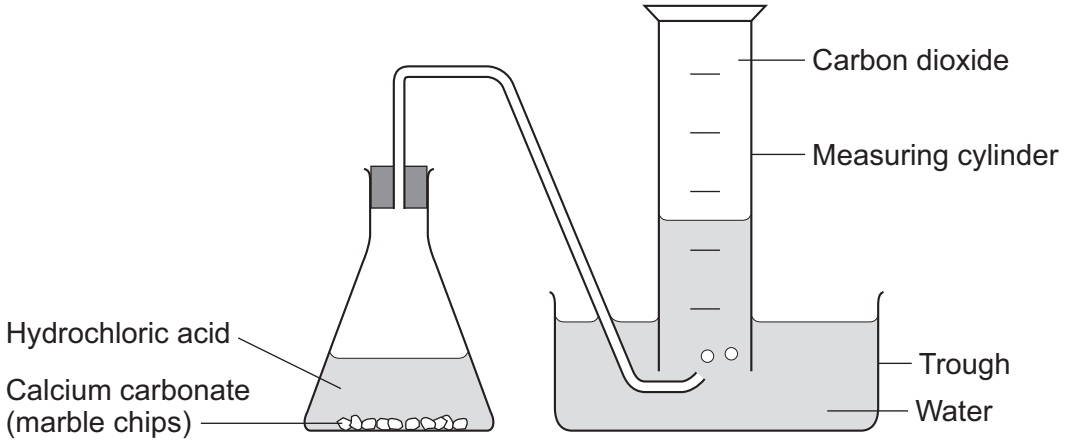
Advice
- In all calculations, show clearly how you work out your answer.

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

1 A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.

The student used the apparatus shown in **Figure 1**.

Figure 1



The student:

- recorded the volume of gas collected every 5 seconds
- repeated the experiment using hydrochloric acid at different temperatures.

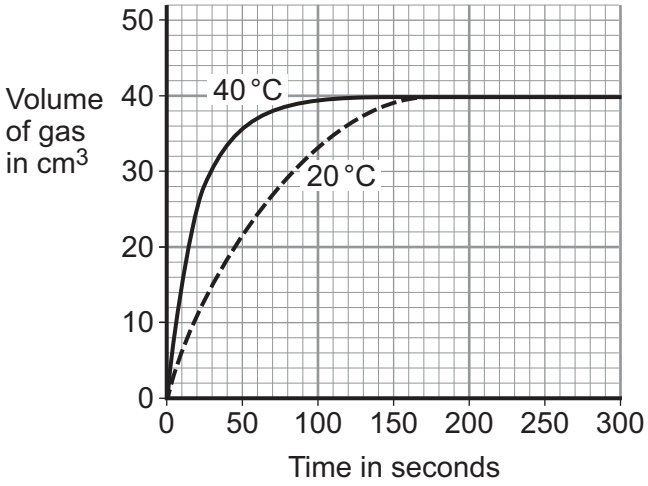
The equation for the reaction is:

$$CaCO_3(s) + 2\,HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

1 (a) The student plotted results for the hydrochloric acid at 20 °C and 40 °C on a graph.

Figure 2 shows the student's graph.

Figure 2



Use information from **Figure 2** to answer these questions.

1 (a) (i) State **one** conclusion the student could make about the effect of temperature on the rate of the reaction.

[1 mark]

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1 (a) (ii) Give **one** reason why the student could make this conclusion.

[1 mark]

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1 (a) (iii) For the hydrochloric acid at 60 °C the student had collected 30 cm^3 after 15 seconds.

Calculate the average rate of reaction from 0 to 15 seconds.

[1 mark]

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.....

Rate of reaction = ... cm^3 per second

1 (b) The student then investigated how the surface area of marble chips affected the rate of reaction.

1 (b) (i) Which **two** variables should the student keep constant?

[2 marks]

Tick (✓) **two** boxes.

Amount of water in the trough ☐

Concentration of acid ☐

Mass of marble chips ☐

Size of marble chips ☐

Volume of measuring cylinder ☐

1 (b) (ii) Explain, in terms of particles and collisions, the effect that increasing the surface area of the marble chips has on the rate of reaction.

[2 marks]

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1 (c) Calcium carbonate is a catalyst for the industrial production of biodiesel.

Give **one** reason why using a catalyst reduces costs.

[1 mark]

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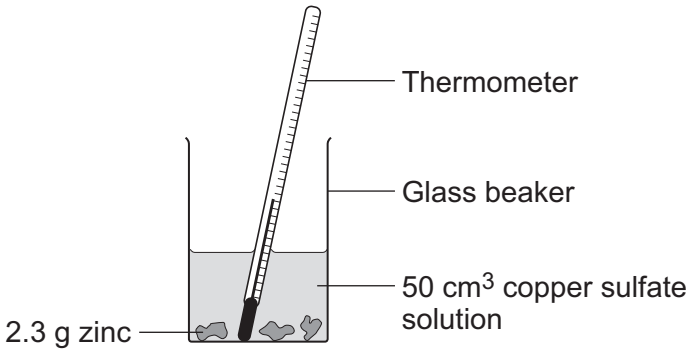
8

2 A student investigated the temperature change when zinc reacts with copper sulfate solution.

The student used a different concentration of copper sulfate solution for each experiment.

The student used the apparatus shown in **Figure 3**.

Figure 3



The student:

- measured 50 cm^3 copper sulfate solution into a glass beaker
- measured the temperature of the copper sulfate solution
- added 2.3 g zinc
- measured the highest temperature
- repeated the experiment using copper sulfate solution with different concentrations.

The equation for the reaction is:

$$Zn(s) + CuSO_4(aq) \longrightarrow Cu(s) + ZnSO_4(aq)$$

zinc + copper sulfate solution ⟶ copper + zinc sulfate solution

2 (a) The thermometer reading changes during the reaction.

Give **one** other change the student could **see** during the reaction.

[1 mark]

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Question 2 continues on the next page

2 (b) Suggest **one** improvement the student could make to the apparatus in **Figure 3**.

Give a reason why this improves the investigation.

[2 marks]

Improvement .....

.....

Reason .....

.....

2 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The student's results are shown in **Table 1**.

Table 1

Experiment number	Concentration of copper sulfate in moles per dm^3	Increase in temperature in °C
1	0.1	5
2	0.2	10
3	0.3	12
4	0.4	20
5	0.5	25
6	0.6	30
7	0.7	35
8	0.8	35
9	0.9	35
10	1.0	35

Describe **and** explain the trends shown in the student's results.

[6 marks]

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Extra space .....

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9

3 This question is about metals and alloys.

3 (a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

[4 marks]

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3 (b) Describe how the structure of an alloy is different from the structure of a pure metal.

[2 marks]

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3 (c) Alloys are used to make dental braces and coins.

3 (c) (i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

[1 mark]

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3 (c) (ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

[1 mark]

.....

.....

3 (c) (iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

[1 mark]

Aluminium is manufactured by the electrolysis of a molten mixture of

cryolite and ..... .

3 (c) (iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

[1 mark]

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3 (d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

[1 mark]

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11

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4 This question is about atoms and isotopes.

4 (a) Atoms contain protons, neutrons and electrons.
A lithium atom has the symbol $^{7}_{3}\text{Li}$

Explain, in terms of sub-atomic particles, why the mass number of this lithium atom is 7.
[3 marks]

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4 (b) Amounts of substances can be described in different ways.

Complete the sentences.
[2 marks]

One mole of a substance is the relative formula mass in ..... .

The relative atomic mass of an element compares the mass of an atom of an element with the mass of an atom of ..... .

4 (c) Two isotopes of oxygen are $^{18}_{8}\text{O}$ and $^{16}_{8}\text{O}$

Describe the similarities and differences between the isotopes $^{18}_{8}\text{O}$ and $^{16}_{8}\text{O}$
You should refer to the numbers of sub-atomic particles in each isotope.
[3 marks]

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8

5 This question is about compounds.

5 (a) **Table 2** gives information about the solubility of some compounds.

Table 2

Soluble compounds
All potassium and sodium salts
All nitrates
Chlorides, bromides and iodides, except those of silver and lead

Use information from **Table 2** to answer these questions.

5 (a) (i) Name a soluble compound that contains silver ions.

[1 mark]

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5 (a) (ii) Name a soluble compound that contains carbonate ions.

[1 mark]

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5 (b) Metal oxides react with acids to make salts.

What type of compound is a metal oxide?

[1 mark]

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5 (c) Lead nitrate solution is produced by reacting lead oxide with nitric acid.

5 (c) (i) State how solid lead nitrate can be obtained from lead nitrate solution.

[1 mark]

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5 (c) (ii) Balance the equation for the reaction.

[1 mark]

$$PbO + HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$$

5 (c) (iii) Give the total number of atoms in the formula $Pb(NO_3)_2$

[1 mark]

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5 (d) An oxide of lead that does **not** have the formula PbO contains 6.21 g of lead and 0.72 g of oxygen.

Calculate the empirical formula of this lead oxide.

Relative atomic masses (A_r): O = 16; Pb = 207

You must show your working to gain full marks.

[4 marks]

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Empirical formula = ...

10

6 This question is about sodium chloride and iodine.

6 (a) Describe the structure and bonding in sodium chloride.

[4 marks]

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6 (b) When sodium chloride solution is electrolysed, one product is chlorine.

Name the **two** other products from the electrolysis of sodium chloride solution.

[2 marks]

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6 (c) Many people do not have enough iodine in their diet.

Sodium chloride is added to many types of food. Some scientists recommend that sodium chloride should have a compound of iodine added.

Give **one** ethical reason why a compound of iodine should **not** be added to sodium chloride used in food.

[1 mark]

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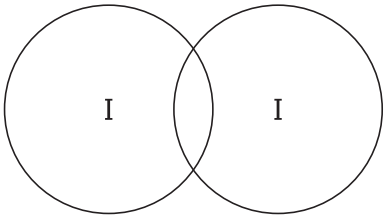
6 (d) The bonding in iodine is similar to the bonding in chlorine.

6 (d) (i) Complete **Figure 4** to show the bonding in iodine.

Show the outer electrons only.

[2 marks]

Figure 4



6 (d) (ii) Explain why iodine has a low melting point.

[3 marks]

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6 (d) (iii) Explain, in terms of particles, why liquid iodine does not conduct electricity.

[2 marks]

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14

END OF QUESTIONS

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