AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
ADDITIONAL SCIENCE
CHEMISTRY

H

Higher Tier Unit Chemistry C2

Wednesday 14 June 2017 Morning Time allowed: 1 hour

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

You may use a calculator.

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 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.

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

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ANSWER IN THE SPACES PROVIDED

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

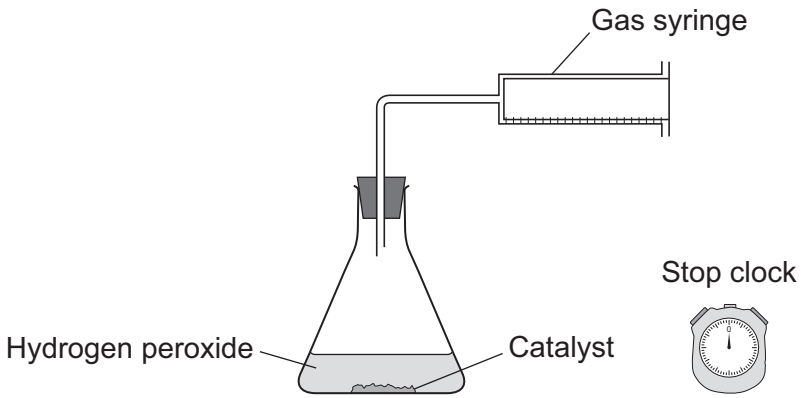
1 This question is about rates of reaction.

The equation for the decomposition of hydrogen peroxide is:

$$2H_2O_2\ (aq) \longrightarrow 2H_2O\ (l) + O_2\ (g)$$

Figure 1 shows the apparatus a student used to investigate the rate of reaction for the decomposition of hydrogen peroxide.

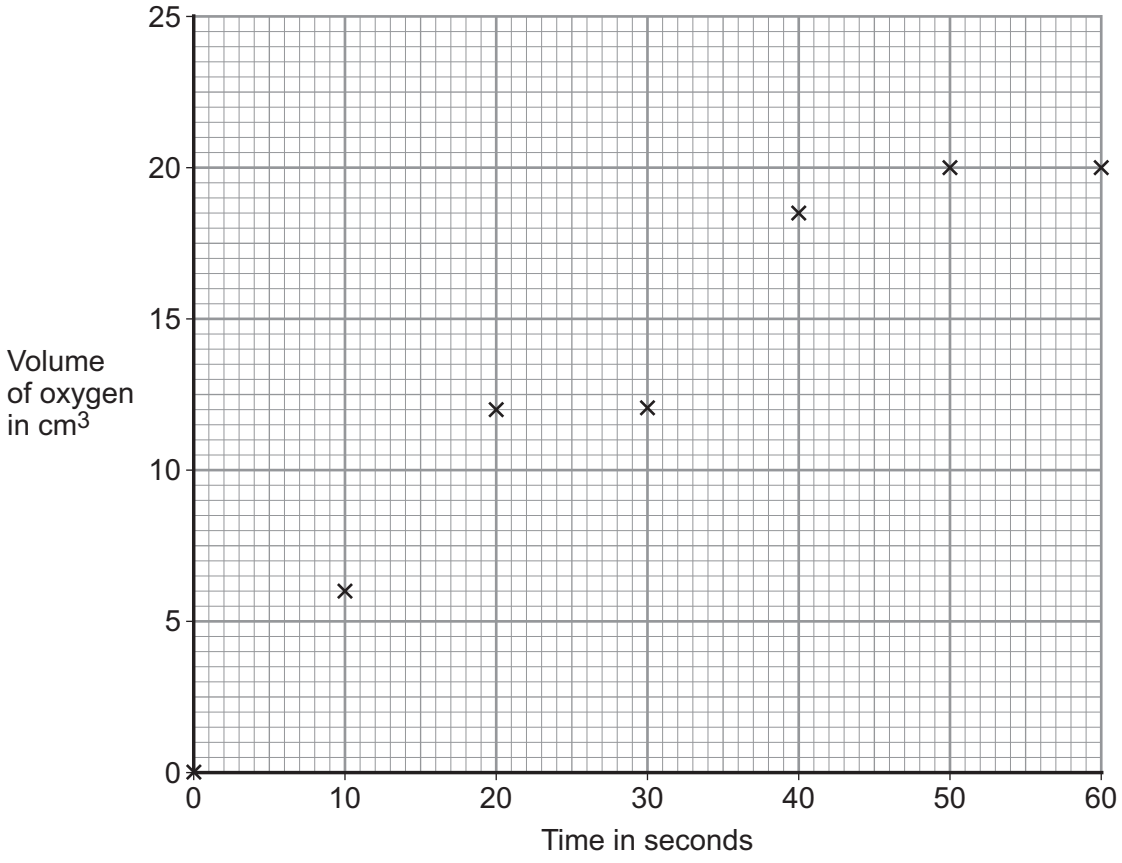
Figure 1



Question 1 continues on the next page

The graph in **Figure 2** shows the results.

Figure 2



1 (a) (i) Draw a smooth curve of best fit on **Figure 2**.

[1 mark]

1 (a) (ii) Give the volume of oxygen produced at 25 seconds.

[1 mark]

Volume of oxygen = _____ cm^3

1 (a) (iii) After how many seconds does the reaction stop?

[1 mark]

Time = _____ seconds

1 (a) (iv) The student concluded that the rate of reaction decreases with time.

Explain how the results support this conclusion.

[2 marks]

1 (a) (v) Calculate the mean rate of reaction during the first 10 seconds.

[1 mark]

Mean rate of reaction = _____ cm^3 per second

1 (b) The student investigated the effect of concentration on the rate of the reaction.

The student repeated the experiment with greater concentrations of hydrogen peroxide.

1 (b) (i) The catalyst was kept the same. Give **two** other control variables.

[2 marks]

Question 1 continues on the next page

1 (b) (ii) State and explain, in terms of particles and collisions, how a greater concentration affects the rate of the reaction.

[3 marks]

1 (c) Describe how increasing the amount of catalyst affects the results in **Figure 2**.

[2 marks]

13

Turn over for the next question

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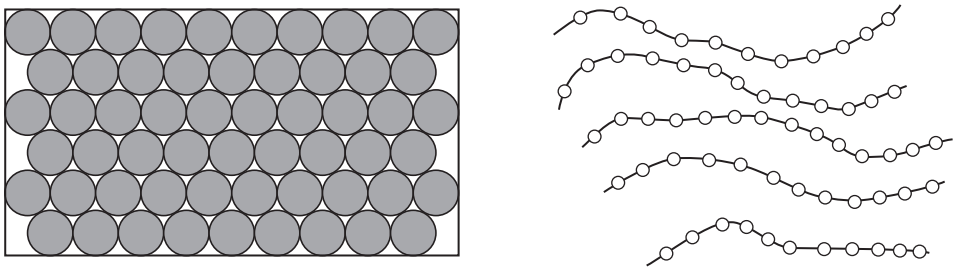
2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Metals and thermosoftening polymers have different properties.

Figure 3 shows structures of a metal and a thermosoftening polymer.

Figure 3



Explain how the properties of a metal and a thermosoftening polymer relate to their structures.

In your answer you should describe the structures of a metal and a thermosoftening polymer.

[6 marks]

Extra space

6

Turn over for the next question

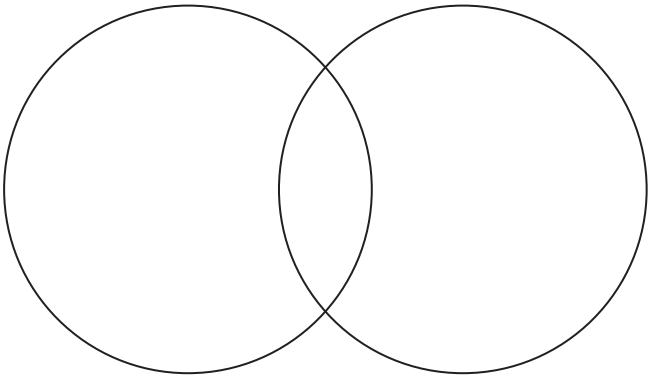
3 This question is about oxygen and substances containing oxygen.

3 (a) (i) Complete **Figure 4** to show the arrangement of the outer shell electrons in an oxygen molecule.

Use dots (•) and crosses (×) to represent the electrons.

[2 marks]

Figure 4



3 (a) (ii) Name the type of bonding in an oxygen molecule.

[1 mark]

_____

3 (a) (iii) Explain why oxygen has a low boiling point.

[2 marks]

_____

_____

_____

_____

3 (b) Magnesium oxide is produced when oxygen reacts with magnesium.

3 (b) (i) **Balance** the equation for the reaction.

[1 mark]

$$Mg + O_2 \longrightarrow MgO$$

3 (b) (ii) Magnesium oxide contains magnesium ions (Mg^{2+}) and oxide ions (O^{2-}).

Describe what happens, in terms of electrons, when magnesium atoms react with oxygen atoms to produce magnesium oxide.

[3 marks]

3 (b) (iii) Magnesium oxide nanoparticles can be made.

What are nanoparticles?

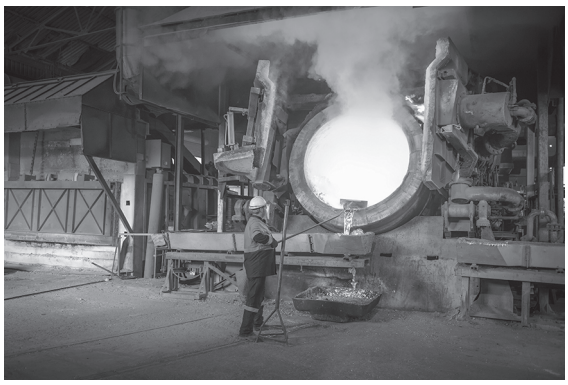
[1 mark]

Question 3 continues on the next page

3 (c) **Figure 5** shows a furnace lined with silicon dioxide (SiO_2).

The temperature in the furnace is 1500 °C.

Figure 5



Explain, in terms of structure and bonding, why silicon dioxide is used to line furnaces.

[3 marks]

13

Turn over for the next question

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4 This question is about sulfuric acid (H_2SO_4) and ethene.

Sulfuric acid is used to produce copper sulfate ($CuSO_4$).

The equation for the reaction is:

$$CuO(s) + H_2SO_4(aq) \longrightarrow CuSO_4(aq) + H_2O(l)$$

4 (a) Describe a method for making copper sulfate crystals from copper oxide and sulfuric acid.

[4 marks]

4 (b) Calculate the mass of copper oxide required to produce 24.95 g of copper sulfate crystals ($CuSO_4.5H_2O$).

Relative formula mass (M_r) of copper sulfate crystals = 249.5

Relative atomic masses (A_r): O = 16; Cu = 63.5

[3 marks]

Mass of copper oxide = _____ g

4 (c) Ethene and sulfuric acid are used to make many substances.

4 (c) (i) **Table 1** shows data about wealth of countries, ethene production and sulfuric acid production.

Table 1

Country	Wealth of country in billions of dollars	Ethene production in kilotonnes	Sulfuric acid production in kilotonnes
A	4000	13 900	36 000
B	1300	4 400	6 600
C	1290	2 700	26 000
D	620	3 100	2 500
E	460	1 500	4 200
F	310	650	6 700

How does the wealth of countries relate to their production of ethene and sulfuric acid?

[2 marks]

4 (c) (ii) Suggest why the use of ethene has increased in the last 50 years.

[1 mark]

10

5 This question is about methods of analysis.

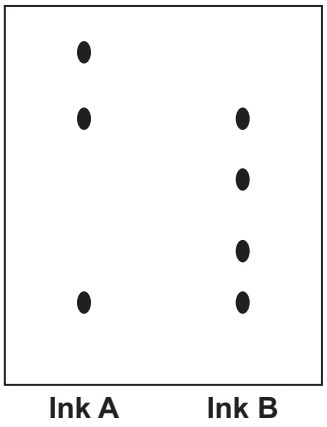
5 (a) A student wanted to compare the colours in two inks, **A** and **B**, using paper chromatography.

5 (a) (i) Describe a method the student could use.

[4 marks]

5 (a) (ii) **Figure 6** shows the student's results.

Figure 6



Compare the colours in the inks **A** and **B**.

[2 marks]

5 (b) A method of instrumental analysis is gas chromatography linked to mass spectrometry (GC-MS).

5 (b) (i) Describe how gas chromatography separates substances in a mixture of compounds.

[3 marks]

5 (b) (ii) A mass spectrometer is used to identify the substances.

What information about each substance is given by the mass spectrometer?

[1 mark]

10

Turn over for the next question

6 This question is about sodium chloride.

6 (a) A student reacted hydrochloric acid and sodium hydroxide solution to produce sodium chloride solution.

The student:

- measured 50 cm^3 of hydrochloric acid into a glass beaker
- measured the initial temperature of the hydrochloric acid
- added 50 cm^3 of sodium hydroxide solution
- stirred the mixture and measured the highest temperature of the solution.

6 (a) (i) The hydrochloric acid and sodium hydroxide solution were the same concentration.

Suggest **one** reason why the temperature change could be greater than expected.

[1 mark]

Tick (✓) **one** box.

The volume of the sodium hydroxide solution was more than 50 cm^3. ☐

The volume of the hydrochloric acid was more than 50 cm^3. ☐

The initial temperature reading was too low. ☐

The highest temperature reading was too low. ☐

6 (a) (ii) The student did the investigation three times.

Table 2 shows the results.

Table 2

Experiment number	Initial temperature of the acid in °C	Highest temperature of solution in °C
1	20	33
2	19	30
3	20	32

What conclusion can you make about the reaction from the results in **Table 2**?

[1 mark]

6 (b) The student electrolysed sodium chloride solution.

6 (b) (i) Explain what happens at the negative electrode and why sodium is **not** produced.

[3 marks]

6 (b) (ii) Chlorine gas is produced at the positive electrode.
Complete the half equation.

[1 mark]

____ Cl^- ⟶ _____ + _____

6 (b) (iii) Explain why the pH of the solution after electrolysis was 14

[2 marks]

8

END OF QUESTIONS

There are no questions printed on this page

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