

Please write clearly in block capitals.

Centre number

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# 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	
<b>TOTAL</b>	



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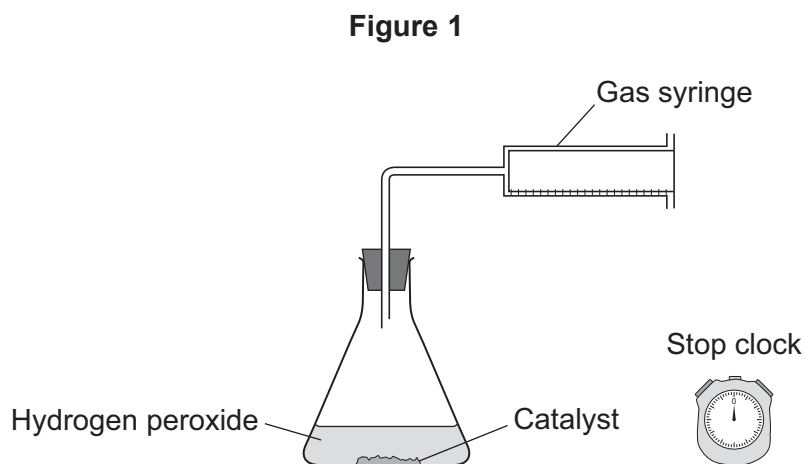
Answer **all** questions in the spaces provided.

**1** This question is about rates of reaction.

The equation for the decomposition of hydrogen peroxide is:



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



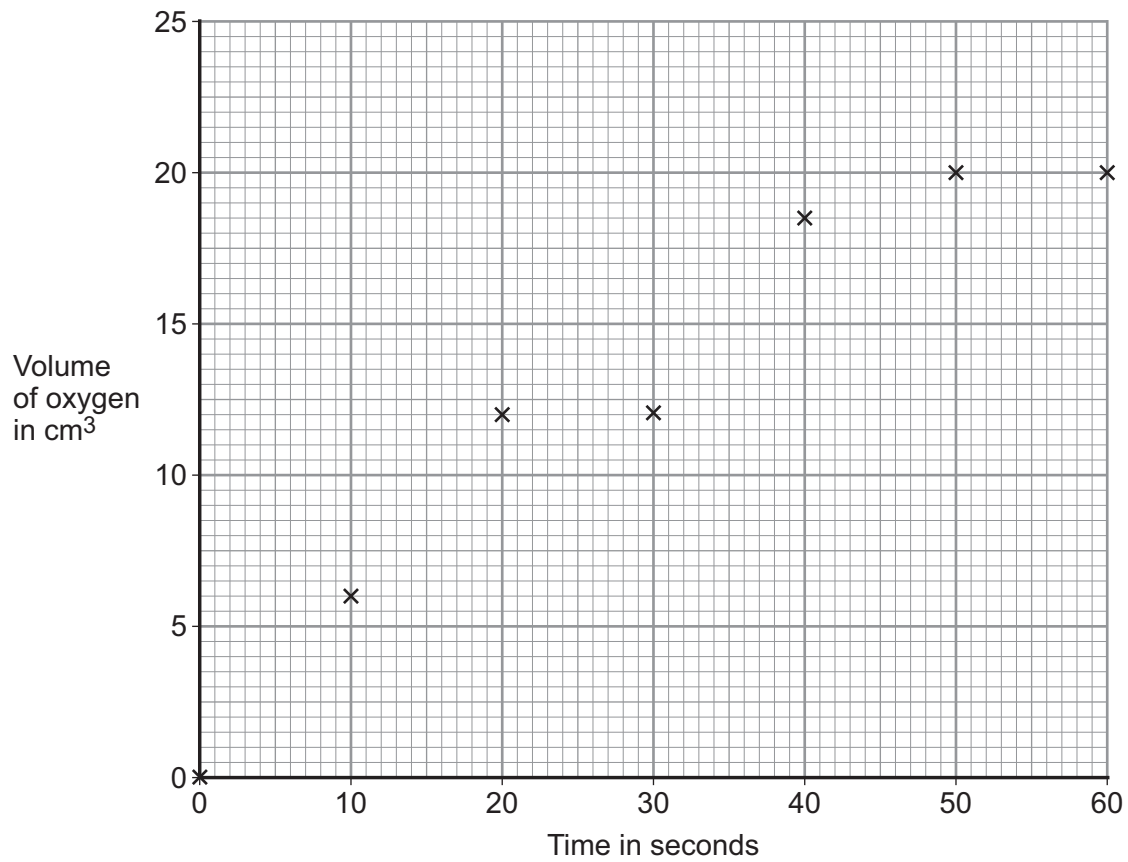
**Question 1 continues on the next page**

**Turn over ►**



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<sup>3</sup>

**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]**

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

**[1 mark]**

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Mean rate of reaction = \_\_\_\_\_ cm<sup>3</sup> 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]**

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

**[3 marks]**

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

**[2 marks]**

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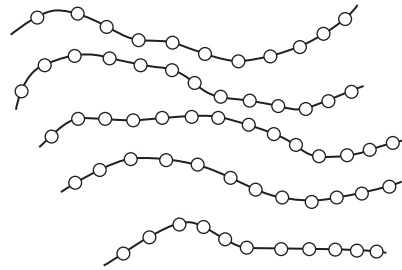
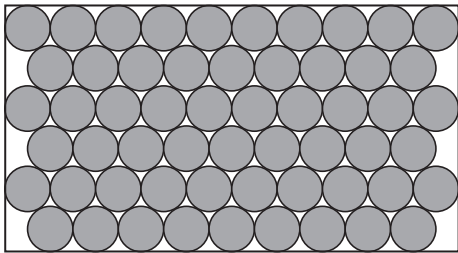


2 In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

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]

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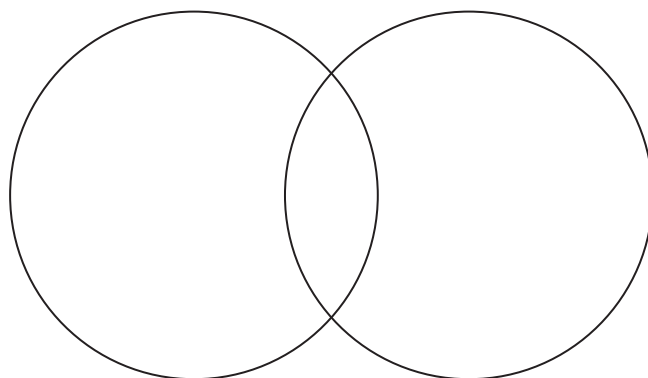
**3** This question is about oxygen and substances containing oxygen.

**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]**

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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



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

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

[1 mark]



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

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

[3 marks]

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

What are nanoparticles?

[1 mark]

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**Question 3 continues on the next page**

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3 (c) **Figure 5** shows a furnace lined with silicon dioxide ( $\text{SiO}_2$ ).

The temperature in the furnace is  $1500\text{ }^\circ\text{C}$ .

**Figure 5**



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

**[3 marks]**

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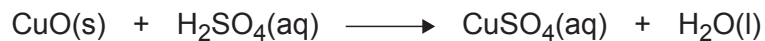
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4 This question is about sulfuric acid ( $\text{H}_2\text{SO}_4$ ) and ethene.

Sulfuric acid is used to produce copper sulfate ( $\text{CuSO}_4$ ).

The equation for the reaction is:



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

[4 marks]

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4 (b) Calculate the mass of copper oxide required to produce 24.95 g of copper sulfate crystals ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ).

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

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

[3 marks]

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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]**

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

**[1 mark]**

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Turn over ►



**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]**

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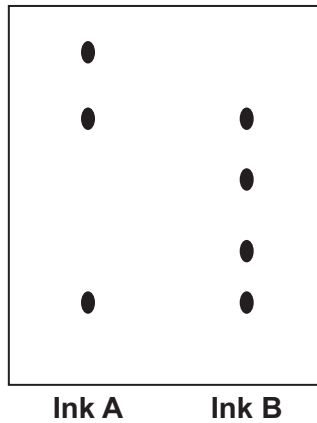
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**5 (a) (ii)** **Figure 6** shows the student's results.

**Figure 6**



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

**[2 marks]**

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**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]**

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**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]**

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**Turn over for the next question**

**Turn over ►**



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<sup>3</sup> of hydrochloric acid into a glass beaker
- measured the initial temperature of the hydrochloric acid
- added 50 cm<sup>3</sup> 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<sup>3</sup>.

The volume of the hydrochloric acid was more than 50 cm<sup>3</sup>.

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]

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**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]

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

[1 mark]



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

[2 marks]

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**END OF QUESTIONS**



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