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 | |

**There are no questions printed on this page**

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**ANSWER IN THE SPACES PROVIDED**

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

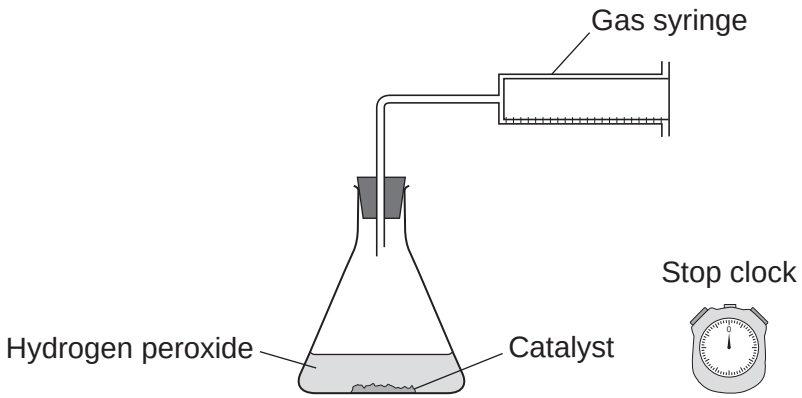
**1** This question is about rates of reaction.

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.

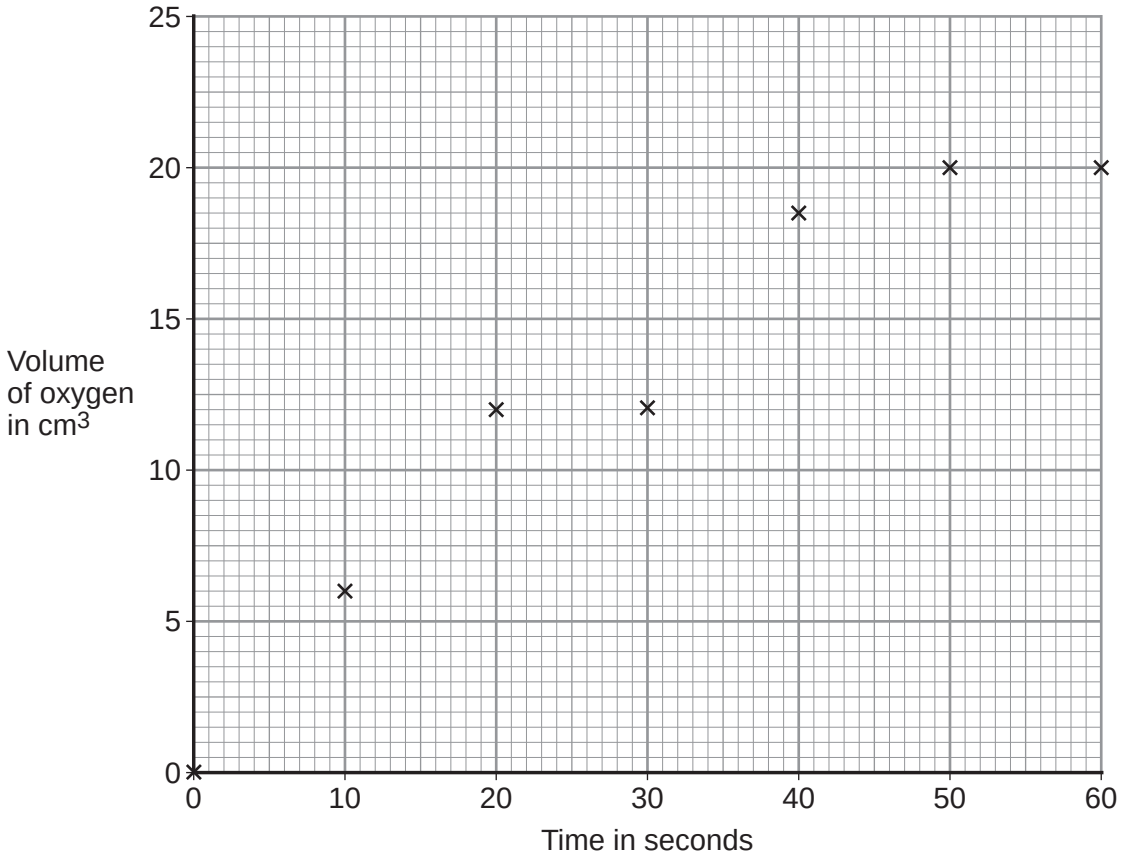
**Figure 1**




**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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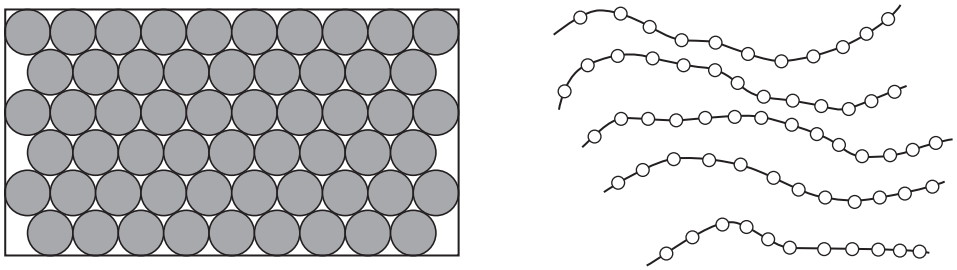
**ANSWER IN THE SPACES PROVIDED**

**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**

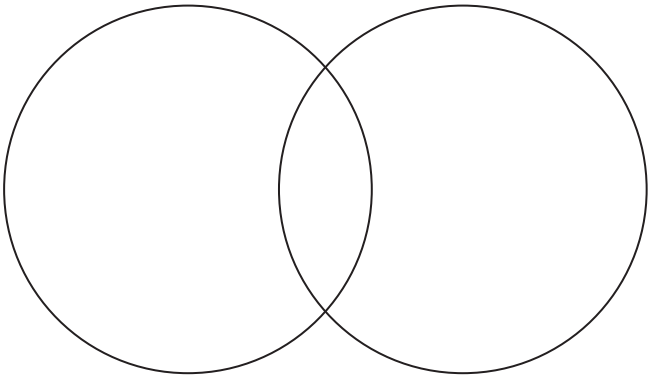
**3** This question is about oxygen and substances containing oxygen.

**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?

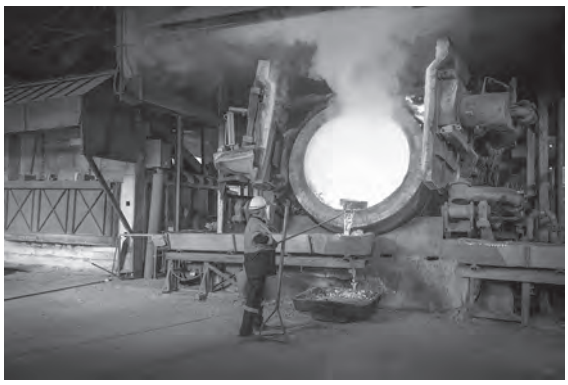
**[1 mark]**

**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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**ANSWER IN THE SPACES PROVIDED**

**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.

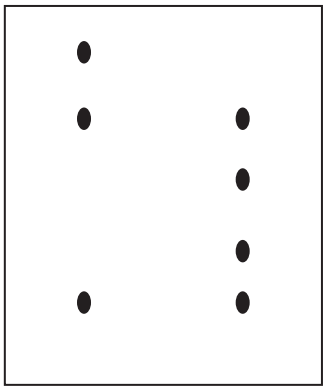
**5 (a)** A student wanted to compare the colours in two inks, **A** and **B**, using paper chromatography.

**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**

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