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# GCSE ADDITIONAL SCIENCE CHEMISTRY

# H

Higher Tier Unit Chemistry C2

Wednesday 15 June 2016

Afternoon

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(d) 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.



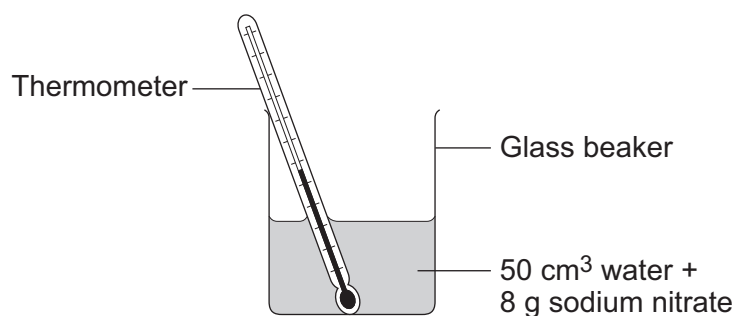
Answer **all** questions in the spaces provided.

**1** This question is about temperature changes.

**1 (a)** A student investigated the temperature change when 8 g of sodium nitrate dissolves in 50 cm<sup>3</sup> of water.

**Figure 1** shows the apparatus the student used.

**Figure 1**



The student did the experiment five times.

**Table 1** shows the results.

**Table 1**

Experiment	Decrease in temperature of water in °C
1	5.9
2	5.7
3	7.2
4	5.6
5	5.8



- 1 (a) (i)** Calculate the mean decrease in temperature.  
Do not use the anomalous result in your calculation.

[2 marks]

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Mean decrease in temperature = \_\_\_\_\_ °C

- 1 (a) (ii)** Suggest **one** change in the apparatus in **Figure 1** which would improve the accuracy of the results.  
Give a reason for your answer.

[2 marks]

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**Question 1 continues on the next page**

**Turn over ►**



- 1 (b) The student investigated the temperature change when different masses of sodium carbonate were added to 50 cm<sup>3</sup> of water at 20 °C.

**Table 2** shows the results.

**Table 2**

Mass of sodium carbonate in g	Final temperature of solution in °C
2.0	21.5
4.0	23.0
6.0	24.5
8.0	26.0
10.0	26.6
12.0	26.6
14.0	26.6

Describe the relationship between the mass of sodium carbonate added and the final temperature of the solution.

Use values from **Table 2** in your answer.

**[3 marks]**

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**Turn over for the next question**

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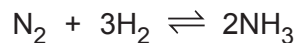


0 5

2 This question is about ammonia and fertilisers.

2 (a) Ammonia is produced by a reversible reaction.

The equation for the reaction is:



Complete the sentence.

[1 mark]

The forward reaction is exothermic, so the reverse reaction is \_\_\_\_\_ .

2 (b) Calculate the percentage by mass of nitrogen in ammonia ( $\text{NH}_3$ ).

Relative atomic masses ( $A_r$ ): H = 1; N = 14

You **must** show how you work out your answer.

[3 marks]

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Percentage by mass of nitrogen = \_\_\_\_\_ %



**2 (c)** A neutral solution can be produced when ammonia reacts with an acid.

**2 (c) (i)** Give the pH of a neutral solution.

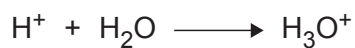
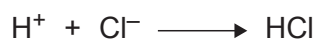
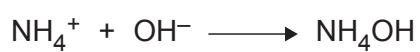
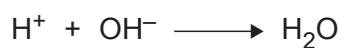
[1 mark]

pH \_\_\_\_\_

**2 (c) (ii)** Which of these ionic equations shows a neutralisation reaction?

[1 mark]

Tick (✓) **one** box.



**2 (c) (iii)** Name the salt produced when ammonia reacts with hydrochloric acid.

[1 mark]

\_\_\_\_\_

**Question 2 continues on the next page**

**Turn over ►**



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

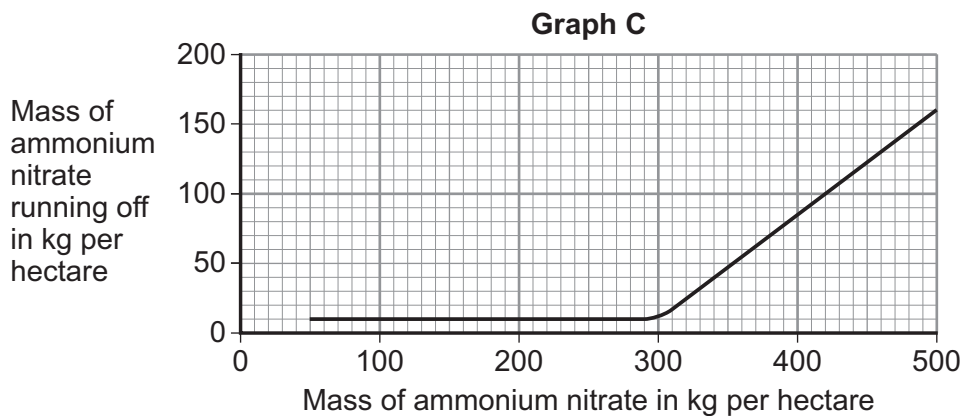
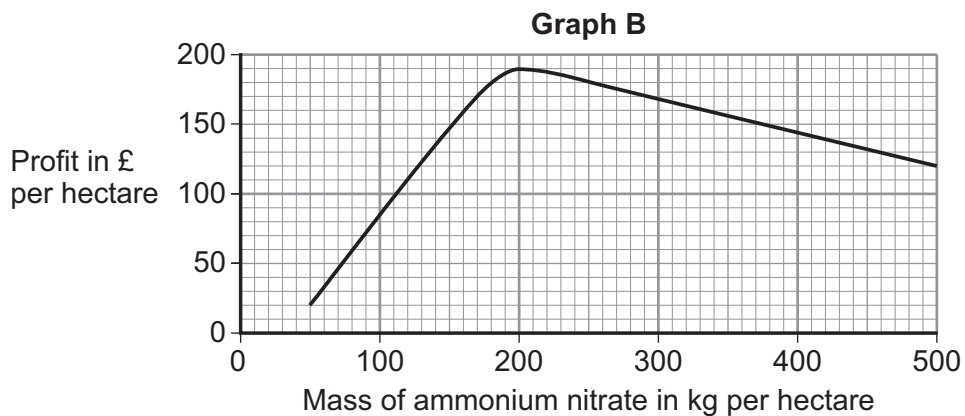
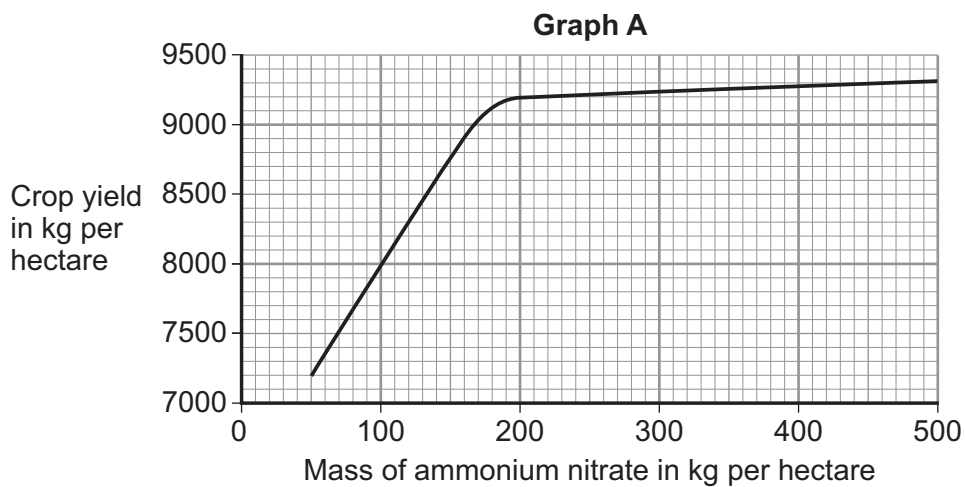
Farmers use ammonium nitrate as a fertiliser for crops.

Rainwater dissolves ammonium nitrate in the soil.

Some of the dissolved ammonium nitrate runs off into rivers and lakes.

**Figure 2** shows three graphs **A**, **B** and **C**. The graphs show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.

**Figure 2**







**3** This question is about atoms, molecules and nanoparticles.

**3 (a)** Different atoms have different numbers of sub-atomic particles.

**3 (a) (i)** An oxygen atom can be represented as  $^{16}_8\text{O}$

Explain why the mass number of this atom is 16.

You should refer to the numbers of sub-atomic particles in the nucleus of the atom.

**[2 marks]**

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**3 (a) (ii)** Explain why  $^{12}_6\text{C}$  and  $^{14}_6\text{C}$  are isotopes of carbon.

You should refer to the numbers of sub-atomic particles in the nucleus of each isotope.

**[3 marks]**

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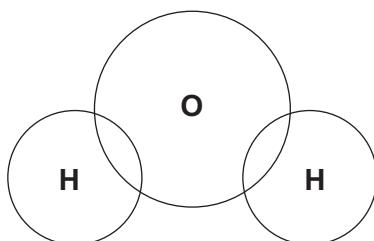
**3 (b)** Hydrogen atoms and oxygen atoms chemically combine to produce water molecules.

**3 (b) (i)** Complete **Figure 3** to show the arrangement of the outer shell electrons of the hydrogen and oxygen atoms in a molecule of water.

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

[2 marks]

**Figure 3**



**3 (b) (ii)** Name the type of bonding in a molecule of water.

[1 mark]

\_\_\_\_\_

**3 (b) (iii)** Why does pure water **not** conduct electricity?

[1 mark]

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

**3 (c)** Nanoparticles of cobalt oxide can be used as catalysts in the production of hydrogen from water.

**3 (c) (i)** How does the size of a nanoparticle compare with the size of an atom?

[1 mark]

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

**3 (c) (ii)** Suggest **one** reason why 1 g of cobalt oxide nanoparticles is a better catalyst than 1 g of cobalt oxide powder.

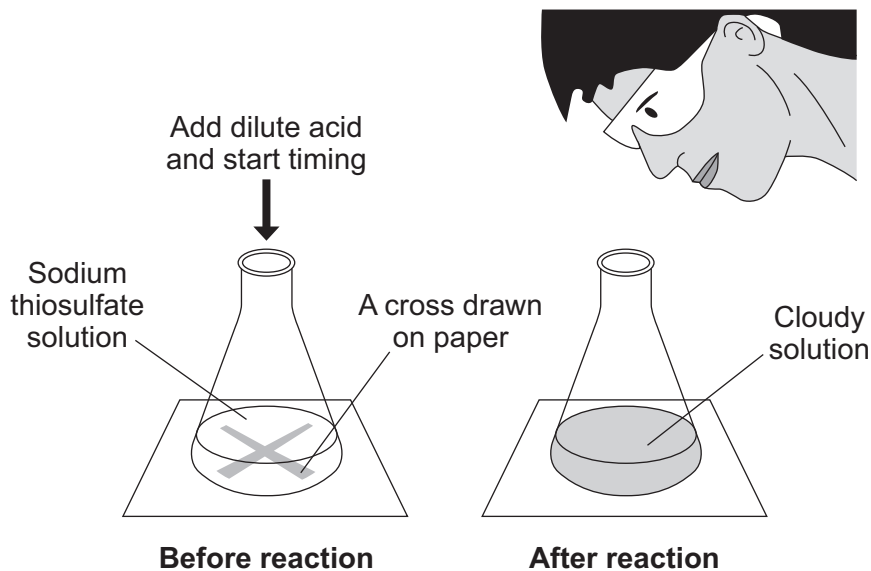
[1 mark]

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



- 4 A student investigated the effect of temperature on the rate of a reaction. **Figure 4** shows an experiment.

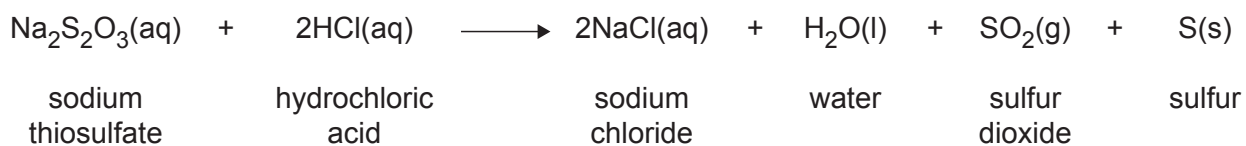
**Figure 4**



The student:

- put sodium thiosulfate solution into a conical flask
- heated the sodium thiosulfate solution to the required temperature
- put the flask on a cross drawn on a piece of paper
- added dilute hydrochloric acid and started a stopclock
- stopped the stopclock when the cross could no longer be seen
- repeated the experiment at different temperatures.

The equation for the reaction is:



4 (a) Explain why the solution goes cloudy.

[2 marks]

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4 (b) Give **two** variables the student must control to make the investigation a fair test.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

4 (c) State the effect that increasing the temperature of the sodium thiosulfate solution has on the rate of the reaction.  
Explain this effect in terms of particles and collisions.

[4 marks]

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4 (d) Suggest how the student should change the method to investigate the rate of reaction at 5 °C.

[1 mark]

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Turn over ►



5 This question is about magnesium and magnesium chloride.

5 (a) Magnesium chloride contains magnesium ions ( $\text{Mg}^{2+}$ ) and chloride ions ( $\text{Cl}^-$ ).

Describe, in terms of electrons, what happens when a magnesium atom reacts with chlorine atoms to produce magnesium chloride.

[4 marks]

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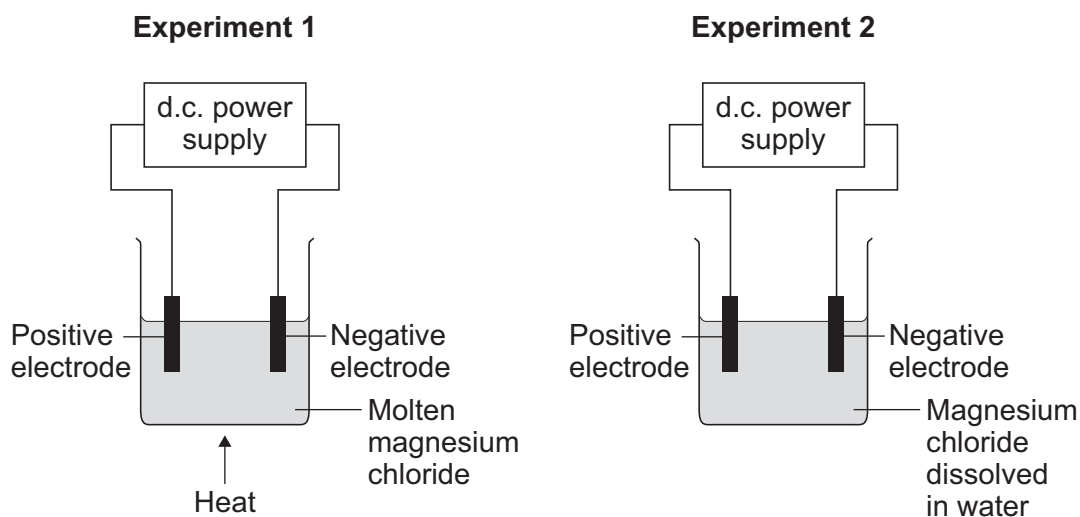
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5 (b) Magnesium chloride can be electrolysed.  
Figure 5 shows two experiments for electrolysing magnesium chloride.

Figure 5



**5 (b) (i)** Explain why magnesium chloride must be molten or dissolved in water to be electrolysed.

[2 marks]

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**5 (b) (ii)** Explain how magnesium is produced at the negative electrode in **Experiment 1**.

[3 marks]

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**5 (b) (iii)** In **Experiment 2** a gas is produced at the negative electrode.  
Name the gas produced at the negative electrode.

[1 mark]

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**5 (b) (iv)** Suggest why magnesium is **not** produced at the negative electrode in **Experiment 2**.

[1 mark]

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**Question 5 continues on the next page**

**Turn over ►**



5 (b) (v) Complete and balance the half equation for the reaction at the positive electrode.

[1 mark]



5 (c) Magnesium is a metal.  
Explain why metals can be bent and shaped.

[2 marks]

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**6** This question is about the properties and uses of materials.  
Use your knowledge of structure and bonding to answer the questions.

**6 (a)** Explain how copper conducts electricity.

**[2 marks]**

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**6 (b)** Explain why diamond is hard.

**[2 marks]**

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**6 (c)** Explain why thermosetting polymers are better than thermosoftening polymers for saucepan handles.

**[2 marks]**

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**END OF QUESTIONS**



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