

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

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.



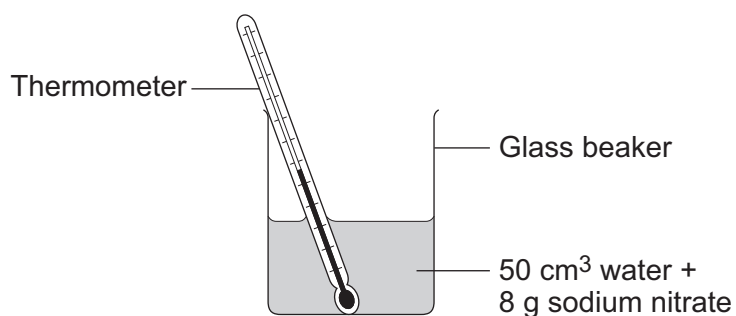
Answer **all** questions in the spaces provided.

1 This question is about temperature changes.

1 (a) A student investigated the temperature change when 8 g of sodium nitrate dissolves in 50 cm³ 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]

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]

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 cm³ 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]



Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**

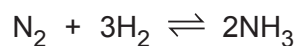
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2 This question is about ammonia and fertilisers.

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 (NH_3).

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

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

[3 marks]

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.

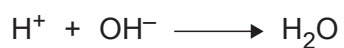
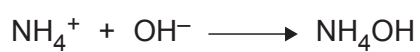
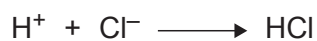
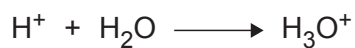
[1 mark]

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

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

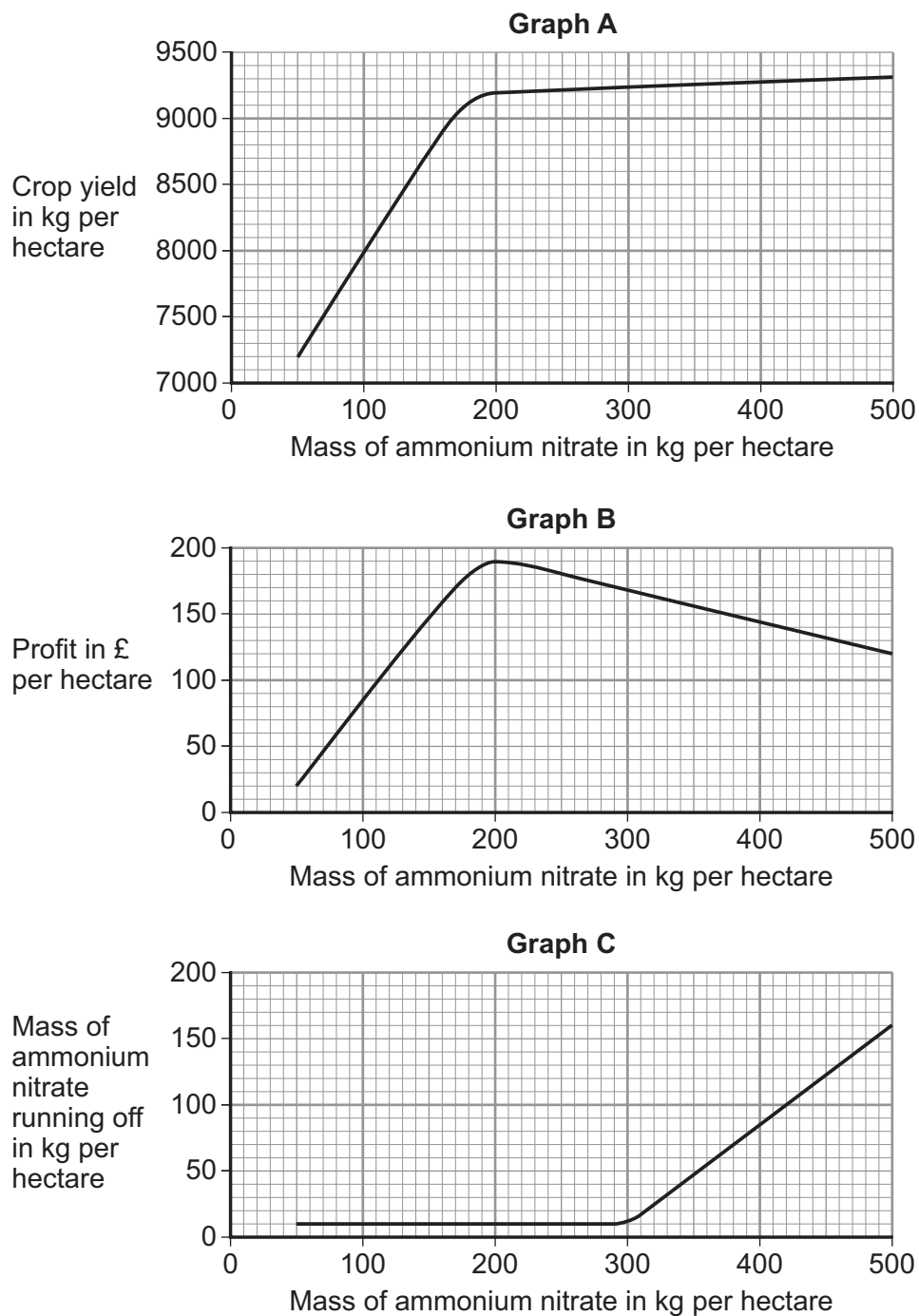
Farmers use ammonium nitrate as a fertiliser for crops.

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



[6 marks]

[illegible]

13

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]

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]



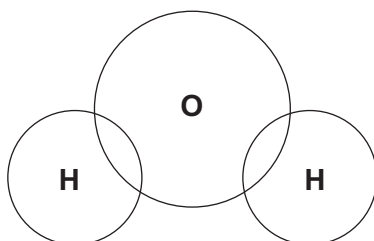
3 (b) Hydrogen atoms and oxygen atoms chemically combine to produce water molecules.

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]

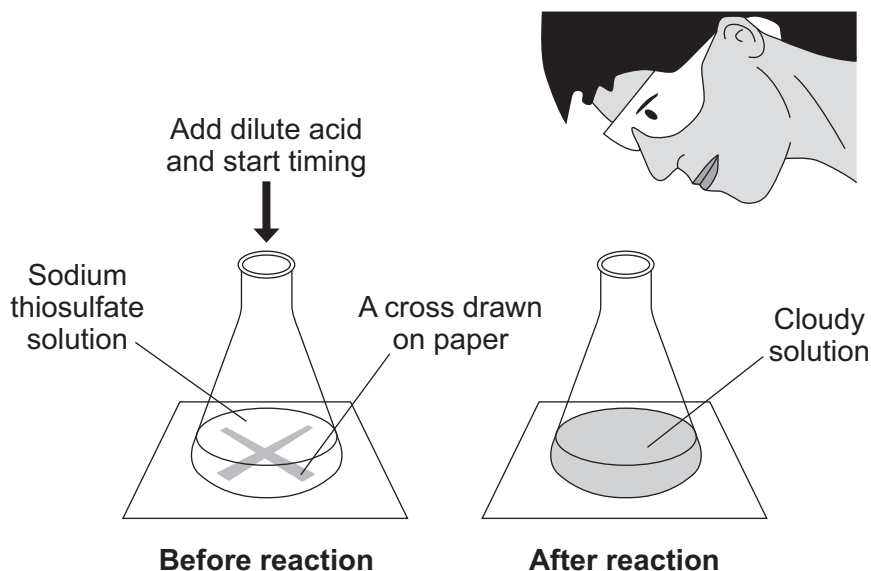
3 (c) (ii) Suggest **one** reason why 1 g of cobalt oxide nanoparticles is a better catalyst than 1 g of cobalt oxide powder.

[1 mark]



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

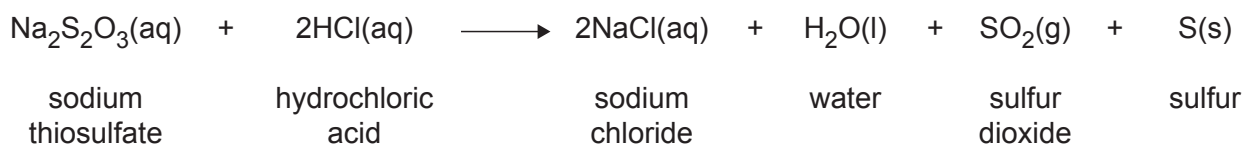
Figure 4



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]

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]

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

[1 mark]

9

Turn over ►



5 This question is about magnesium and magnesium chloride.

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

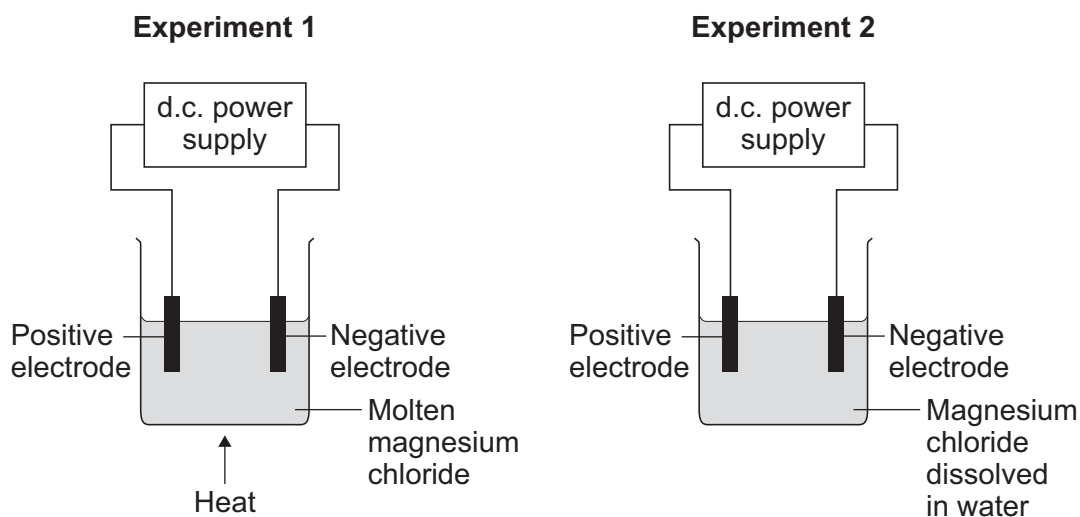
Describe, in terms of electrons, what happens when a magnesium atom reacts with chlorine atoms to produce magnesium chloride.

[4 marks]

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]

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

[3 marks]

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

[1 mark]

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

[1 mark]

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]

14



- 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]

6 (b) Explain why diamond is hard.

[2 marks]

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

[2 marks]

END OF QUESTIONS



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