![AQA logo]

GCSE
ADDITIONAL SCIENCE
CHEMISTRY

F

Foundation 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 6(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
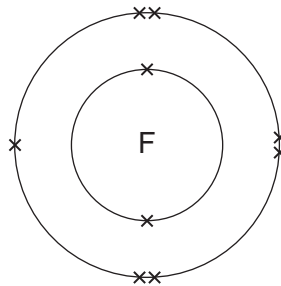● In all calculations, show clearly how you work out your answer.

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

1 This question is about fluorine.

1 (a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

Figure 1

1 (a) (i) In which group of the periodic table is fluorine?

[1 mark]

Group _____

1 (a) (ii) Complete **Table 1** to show the particles in an atom and their relative masses.

[2 marks]

Table 1

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

1 (a) (iii) Use the correct answer from the box to complete the sentence.

[1 mark]

alkalis	alloys	isotopes

Atoms of fluorine with different numbers of neutrons are called _____ .

1 (b)   Sodium reacts with fluorine to produce sodium fluoride.

1 (b) (i)   Complete the word equation for this reaction.

[1 mark]

sodium   +   _____   ⟶   _____

1 (b) (ii)   Complete the sentence.

[1 mark]

Substances in which atoms of two or more different elements are chemically combined

are called _____ .

1 (b) (iii)   The relative formula mass (M_r) of sodium fluoride is 42.

Use the correct answer from the box to complete the sentence.

[1 mark]

ion	mole	molecule

The relative formula mass (M_r), in grams, of sodium fluoride is one _____

of the substance.

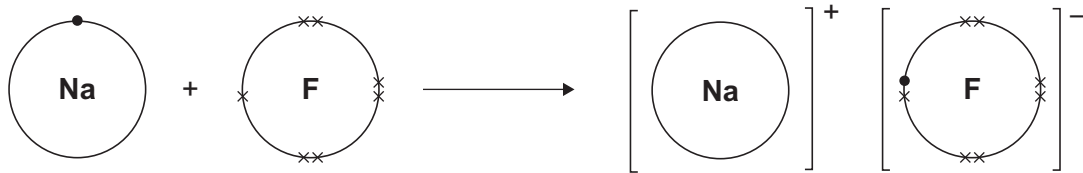**Question 1 continues on the next page**

Turn over ▶

1 (b) (iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (●) and crosses (×) represent electrons.

Figure 2

Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

1 (b) (v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

[2 marks]

Tick (✓) **two** boxes.

Dissolve in water ☐

Gas at room temperature ☐

High melting point ☐

Low boiling point ☐

13

Turn over for the next question

Turn over ▶

2 This question is about substances containing carbon atoms.

2 (a) Diamond is made of carbon atoms.

2 (a) (i) Diamond is used for tips of drills.

Figure 3 shows a drill.

Figure 3

Give **one** reason why diamond is used for tips of drills.

[1 mark]

_____

_____

2 (a) (ii) Diamond nanoparticles can be made.

Use the correct answer from the box to complete the sentence.
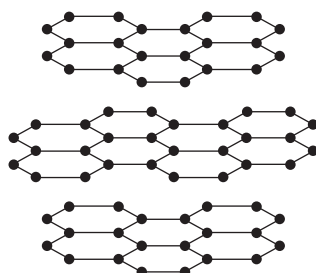
[1 mark]

hundred	million	thousand

Nanoparticles contain a few _____ atoms.

2 (b) Graphite is made of carbon atoms.

Figure 4 shows the structure of graphite.

Figure 4

2 (b) (i) What type of bonding does graphite have?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

2 (b) (ii) How many carbon atoms does each carbon atom bond to in graphite?

[1 mark]

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

2 (b) (iii) What is a property of graphite?

[1 mark]

Tick (✓) **one** box.

Dissolves in water ☐

Has a low melting point ☐

Soft and slippery ☐

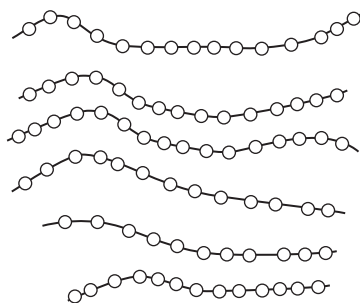**Question 2 continues on the next page**

Turn over ▶

2 (c) Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

Figure 5 shows the structure of a thermosoftening polymer.

Figure 5

2 (c) (i) Complete the sentence.

[1 mark]

Between the polymer chains in a thermosoftening polymer there

are no _____ .

2 (c) (ii) Use the correct answer from the box to complete the sentence.

[1 mark]

condense	dissolve	melt

Heating would cause a thermosoftening polymer to _____ .

2 (c) (iii) Many ethene molecules react together to make poly(ethene).

Different types of poly(ethene) can be made by changing the conditions for the reaction.
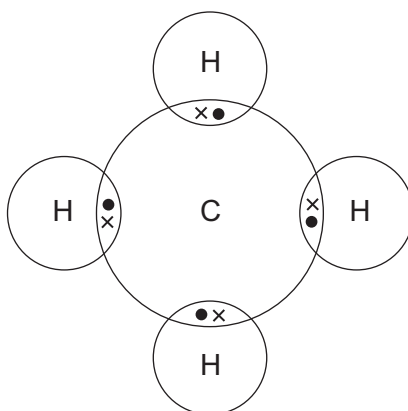Suggest **two** conditions that could be changed.

[2 marks]

1 _____

2 _____

2 (d)   **Figure 6** shows how the atoms are bonded in methane.

Figure 6

2 (d) (i)   What is the formula for methane?

[1 mark]

Tick (✓) **one** box.

C_4H ☐

CH_4 ☐

C_4H_4 ☐

2 (d) (ii)   Methane has a low boiling point.

What does methane consist of?
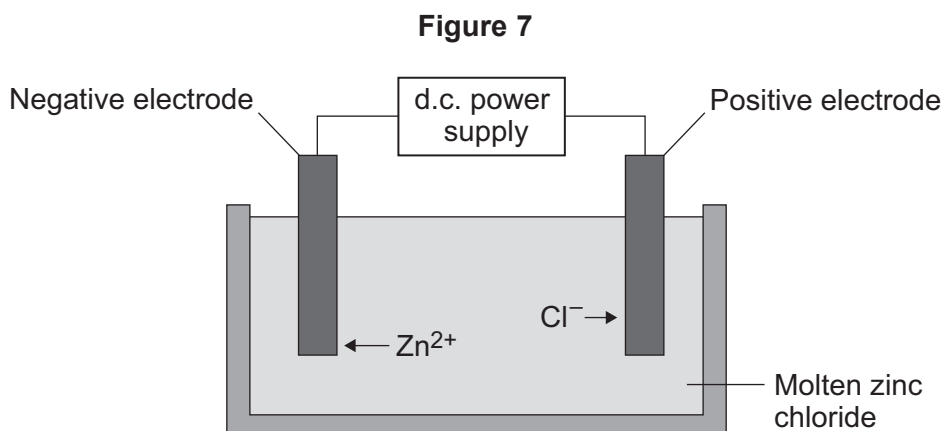
[1 mark]

Tick (✓) **one** box.

Charged ions   ☐

A giant lattice   ☐

Small molecules   ☐

11

Turn over ▶

3 This question is about zinc.

Figure 7 shows the electrolysis of molten zinc chloride.

Figure 7

3 (a) Zinc chloride is an ionic substance.
Complete the sentence.

[1 mark]

When zinc chloride is molten, it will conduct _____ .

3 (b) Zinc ions move towards the negative electrode where they gain electrons to produce zinc.

3 (b) (i) Name the product formed at the positive electrode.

[1 mark]

_____

3 (b) (ii) Explain why zinc ions move towards the negative electrode.

[2 marks]

_____

_____

_____

_____

3 (b) (iii) What type of reaction occurs when the zinc ions gain electrons?

[1 mark]

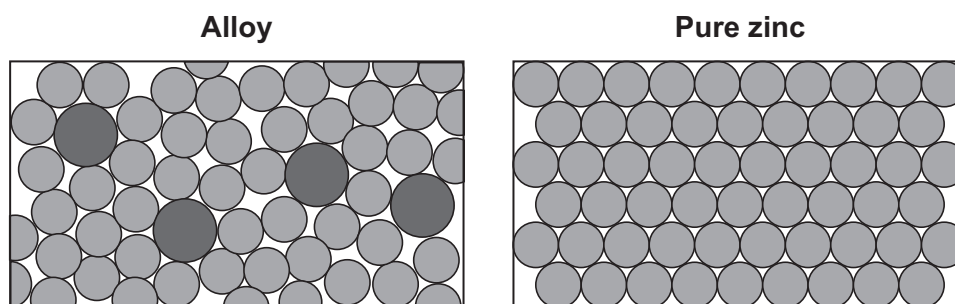Tick (✓) **one** box.

Neutralisation ☐

Oxidation ☐

Reduction ☐

3 (c) Zinc is mixed with copper to make an alloy.

3 (c) (i) **Figure 8** shows the particles in the alloy and in pure zinc.

Figure 8

Alloy   Pure zinc

Use **Figure 8** to explain why the alloy is harder than pure zinc.

[2 marks]

_____

_____

_____

_____

3 (c) (ii) Alloys can be bent. Some alloys return to their original shape when heated.

What name is used for these alloys?

[1 mark]

_____

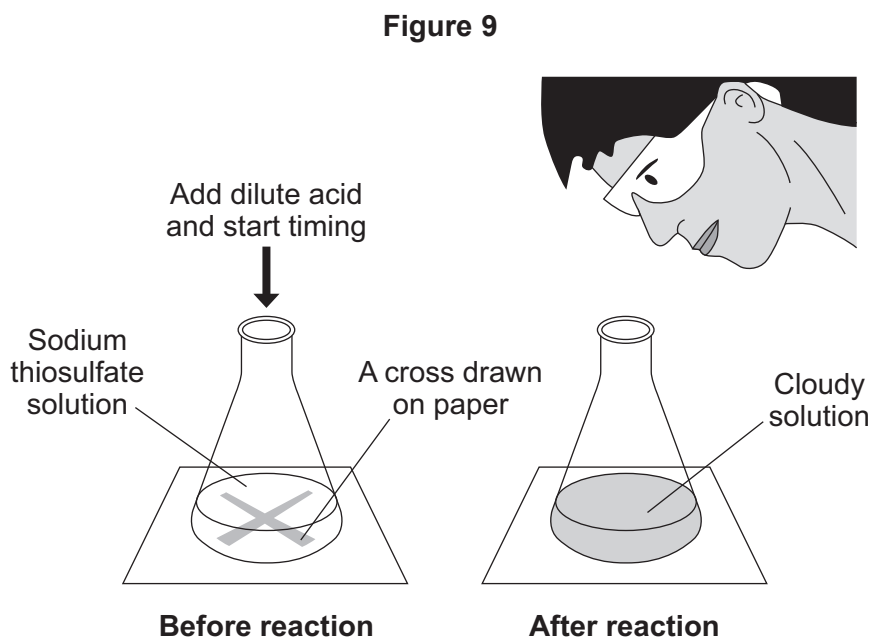**Turn over ▶**

8

4 A student investigated the effect of temperature on the rate of a reaction.

Figure 9 shows an experiment.

Figure 9

Add dilute acid and start timing

Sodium thiosulfate solution

A cross drawn on paper

Cloudy solution
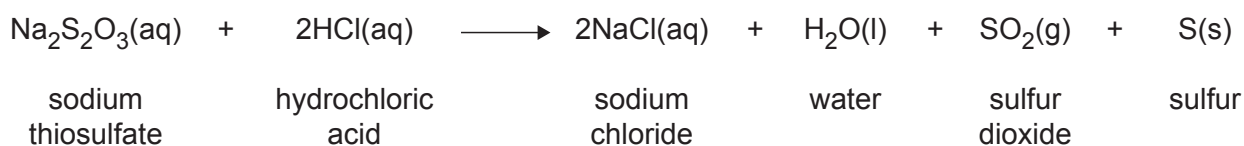
Before reaction　　　　**After reaction**

The student:

- put 50 cm³ 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 5 cm³ dilute hydrochloric acid and started a stopclock
- stopped the stopclock when the cross could no longer be seen
- repeated the experiment at different temperatures.
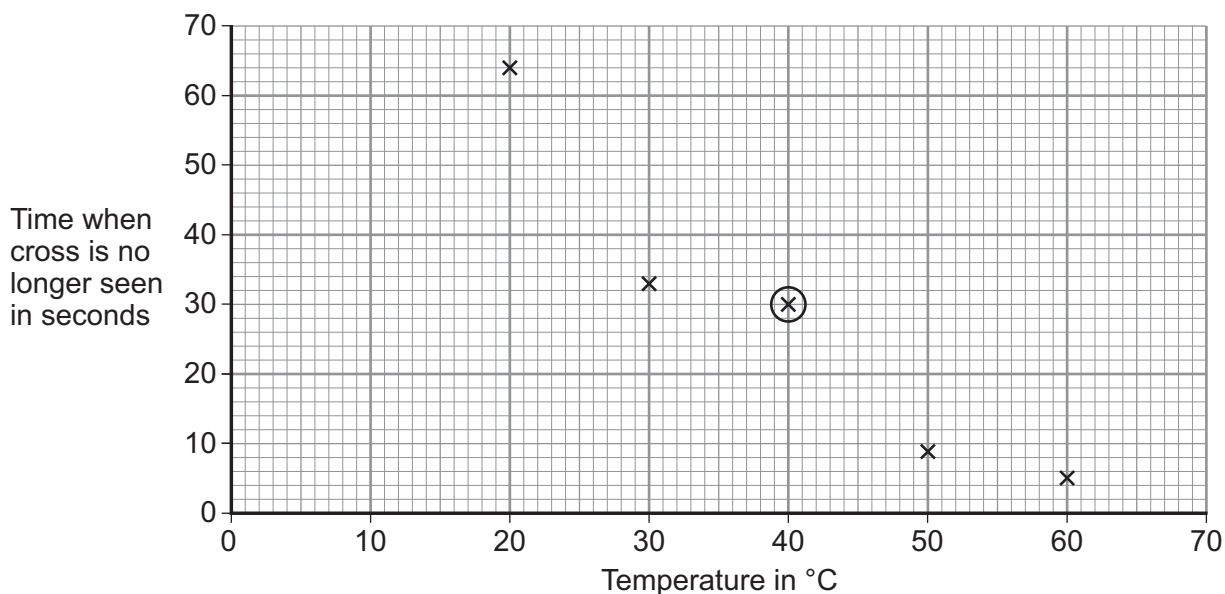
The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

| sodium thiosulfate | hydrochloric acid | sodium chloride | water | sulfur dioxide | sulfur |

4 (a) Which product is a gas?

[1 mark]

_____

4 (b) **Figure 10** shows the results of this experiment at five different temperatures. The circled result point is anomalous.

Figure 10

4 (b) (i) Draw a line of best fit on **Figure 10** to show how the reaction time varied with reaction temperature.

[1 mark]

4 (b) (ii) Give a possible reason for the anomalous result at 40 °C.

[1 mark]

_____

_____

Question 4 continues on the next page

Turn over ▶

4 (b) (iii) The reaction at 20 °C produced 0.32 g of sulfur in 64 seconds.

Calculate the rate of the reaction at 20 °C using the equation:

$$\text{Rate of reaction} = \frac{\text{mass of sulfur}}{\text{time}}$$

[2 marks]

_____

_____

_____

_____

Rate of reaction = _____ grams per second

4 (b) (iv) Give **two** reasons why the rate of the reaction increases as the temperature increases.

[2 marks]

Tick (✓) **two** boxes.

The particles move faster. ☐

The particles collide less often. ☐

All the particles have the same energy. ☐

The particles collide with more energy. ☐

The number of particles increases. ☐

4 (b) (v) Use the correct answer from the box to complete the sentence.

[1 mark]

activation	collision	exothermic

The minimum amount of energy particles must have to react is called

the _____ energy.

8

Turn over for the next question

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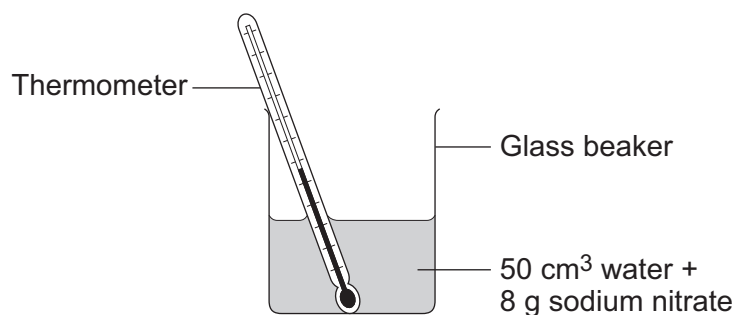**ANSWER IN THE SPACES PROVIDED**

5   This question is about temperature changes.

5 (a)   A student investigated the temperature change when 8 g of sodium nitrate dissolves in 50 cm^3 of water.

Figure 11 shows the apparatus the student used.

Figure 11

Thermometer

Glass beaker

50 cm^3 water + 8 g sodium nitrate

The student did the experiment five times.
Table 2 shows the results.

Table 2

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

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

[2 marks]

Mean decrease in temperature = _____ °C

5 (a) (ii) Suggest **one** change in the apparatus in **Figure 11** which would improve the accuracy of the results.
Give a reason for your answer.

[2 marks]

Question 5 continues on the next page

Turn over ▶

5 (b) The student investigated the temperature change when different masses of sodium carbonate were added to 50 cm^3 of water at 20 °C.

Table 3 shows the results.

Table 3

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 3** in your answer.

[3 marks]

_____

_____

_____

_____

_____

_____

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Turn over ▶

6 This question is about ammonia and fertilisers.

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

The equation for the reaction is:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$
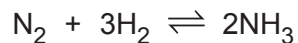
Complete the sentence.

[1 mark]

The forward reaction is exothermic, so the reverse reaction is _____ .

6 (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]

_____

_____

_____

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_____

_____

Percentage by mass of nitrogen = _____%

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

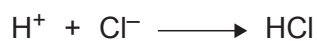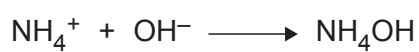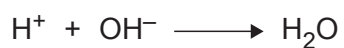**6 (c) (i)** Give the pH of a neutral solution.

[1 mark]

pH _____

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

[1 mark]

Tick (✓) **one** box.

$H^+ + OH^- \longrightarrow H_2O$ ☐

$NH_4^+ + OH^- \longrightarrow NH_4OH$ ☐

$H^+ + Cl^- \longrightarrow HCl$ ☐

$H^+ + H_2O \longrightarrow H_3O^+$ ☐
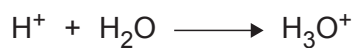
6 (c) (iii) Name the salt produced when ammonia reacts with hydrochloric acid.

[1 mark]

_____

Question 6 continues on the next page

Turn over ▶

6 (d) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**
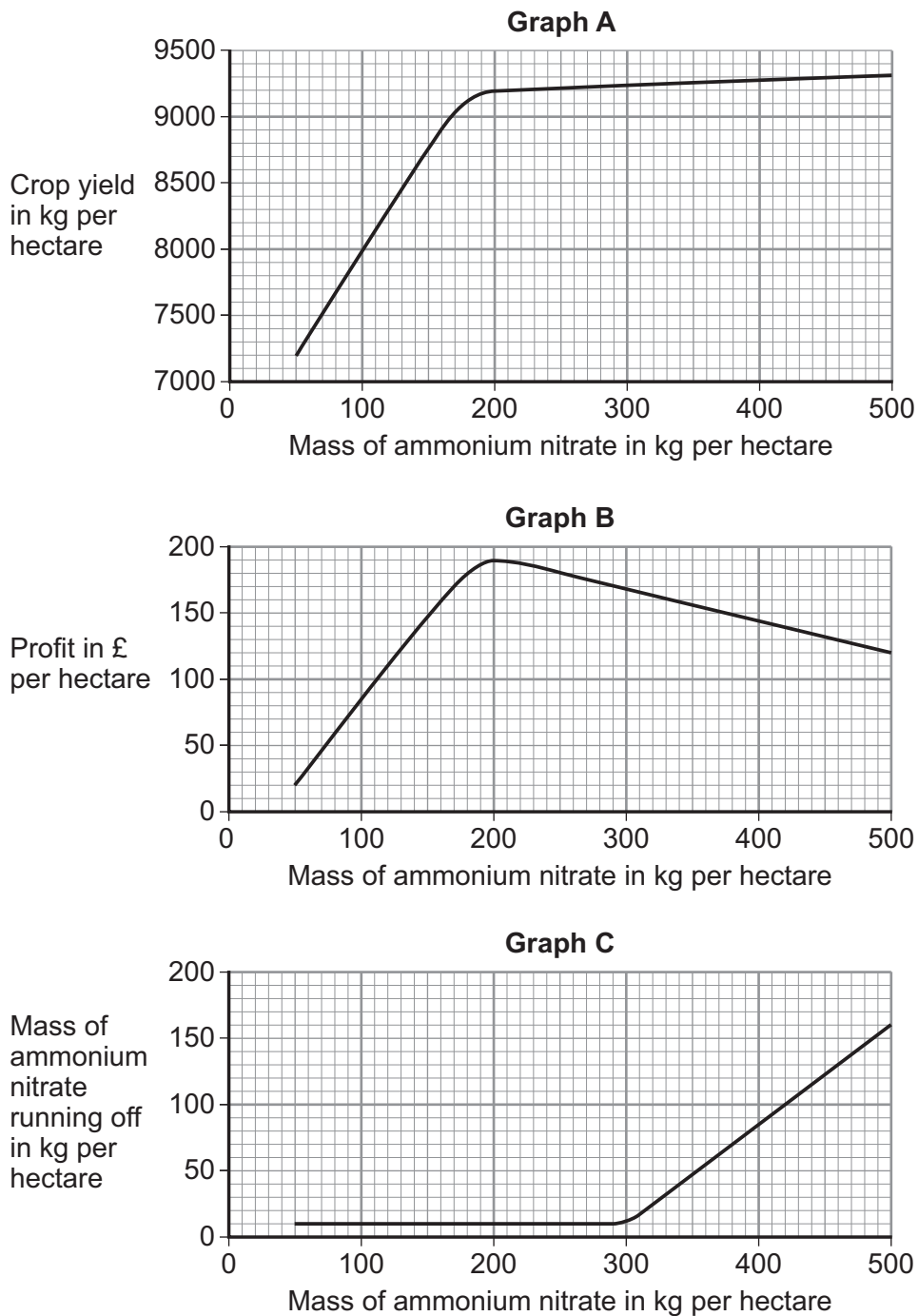
Farmers use ammonium nitrate as a fertiliser for crops.

Rainwater dissolves ammonium nitrate in the soil.

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

Figure 12 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 12

Graph A — Crop yield in kg per hectare vs Mass of ammonium nitrate in kg per hectare

Graph B — Profit in £ per hectare vs Mass of ammonium nitrate in kg per hectare

Graph C — Mass of ammonium nitrate running off in kg per hectare vs Mass of ammonium nitrate in kg per hectare

Suggest how much ammonium nitrate farmers should use per hectare.
Give reasons for your answer.
Use information from graphs **A**, **B** and **C**.

[6 marks]

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Extra space _____

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13

END OF QUESTIONS

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