Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
June 2014

Additional Science
Unit Chemistry C2

CH2HP

H

Chemistry
Unit Chemistry C2

Thursday 15 May 2014 9.00 am to 10.00 am

For this paper you must have:
- a ruler
- the Chemistry Data Sheet (enclosed).

You may use a calculator.

A

Time allowed
- 1 hour

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.

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

1 The label shows the ingredients in a drink called Cola.

Cola

Ingredients:

Carbonated water
Sugar
Colouring
Phosphoric acid
Flavouring
Caffeine

1 (a) (i) The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

[1 mark]

.....

1 (a) (ii) Which ion causes the pH to be 2.9?

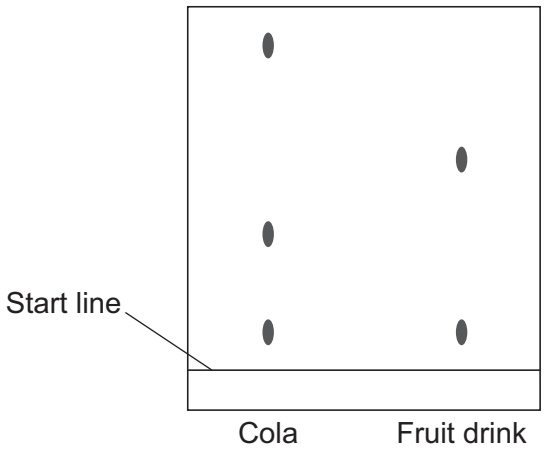
[1 mark]

.....

1 (b) A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in **Figure 1** shows the student's results.

Figure 1



1 (b) (i) Complete the sentence.

The start line should be drawn with a ruler and ..... .

Give a reason for your answer.

[2 marks]

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1 (b) (ii) Suggest **three** conclusions you can make from the student's results.

[3 marks]

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1 (c) Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

[1 mark]

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1 (d) Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

1 (d) (i) Only **one** of the questions in the table **can** be answered by science alone.

Tick (✓) **one** question.

[1 mark]

Question	Tick (✓)
Should caffeine be an ingredient in drinks?	
Is there caffeine in a certain brand of drink?	
How much caffeine should people drink?	

1 (d) (ii) Give **two** reasons why the other questions **cannot** be answered by science alone.

[2 marks]

Reason 1 .....

.....

Reason 2 .....

.....

11

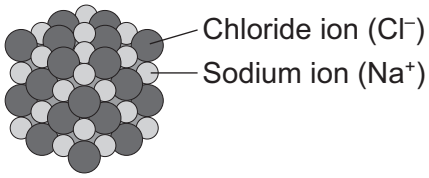
2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

Chlorine

Cl — Cl

Sodium chloride



Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

[6 marks]

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Extra space .....

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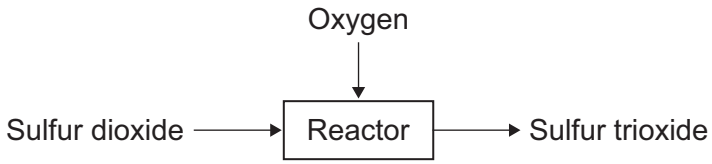
6

3 **Figure 2** represents a reaction in the production of sulfuric acid.

Figure 2



3 (a) Complete and balance the equation for the reaction.

[2 marks]

..... $SO_2(g)$ + ... (g) $\rightleftharpoons$ ..... $SO_3(g)$

3 (b) The conditions can affect the rate of the reaction.

3 (b) (i) The pressure of the reacting gases was increased.

State the effect of increasing the pressure on the rate of reaction.

Explain your answer in terms of particles.

[3 marks]

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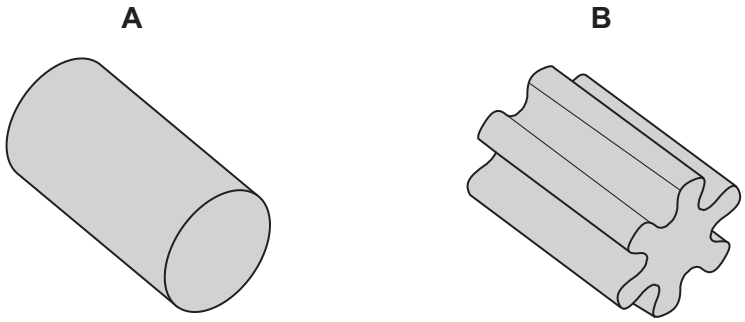
3 (b) (ii) A catalyst is used for the reaction.

The gases pass through a layer containing pieces of the catalyst.

Figure 3 shows the shapes of pieces of catalyst.

Figure 3



Suggest and explain why shape **B** is more effective as a catalyst than shape **A**.

[2 marks]

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3 (c) The reaction is carried out at a high temperature to provide the reactants with the **activation energy**.

What is meant by the **activation energy**?

[1 mark]

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3 (d) Sulfuric acid reacts with metals to produce salts.

3 (d) (i) A student concluded that potassium would **not** be a suitable metal to react with sulfuric acid.

Explain why.

[2 marks]

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3 (d) (ii) A student reacted zinc metal with sulfuric acid to produce a salt and another product.

Complete the equation for this reaction.

[2 marks]

$Zn + H_2SO_4 \longrightarrow$ ..... + ...

3 (d) (iii) The student wanted to increase the rate of the reaction between the zinc and sulfuric acid.

State **one** way, other than using a catalyst, that the student could increase the rate of the reaction.

[1 mark]

.....

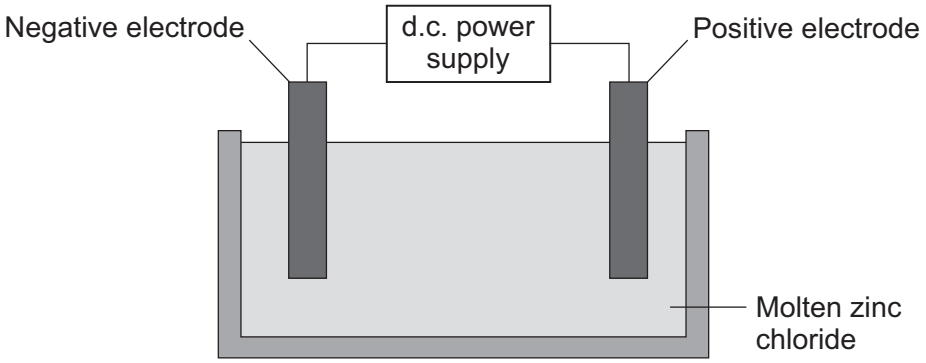
.....

13

4 This question is about zinc and magnesium.

Zinc is produced by electrolysis of molten zinc chloride, as shown in **Figure 4**.

Figure 4



4 (a) (i) Why must the zinc chloride be molten for electrolysis?

[1 mark]

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4 (a) (ii) Describe what happens at the negative electrode.

[3 marks]

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4 (a) (iii) Complete the half equation for the reaction at the positive electrode.

[1 mark]

..... $\longrightarrow$ Cl_2 + ... e^-

4 (b) Magnesium can be produced from magnesium oxide.

The equation for the reaction is:

$$Si(s) + 2\,MgO(s) \rightleftharpoons SiO_2(s) + 2\,Mg(g)$$

4 (b) (i) How can you tell from the equation that the reaction is done at a high temperature?

[1 mark]

.....

.....

4 (b) (ii) This reaction to produce magnesium from magnesium oxide is **endothermic**.

What is meant by an **endothermic** reaction?

[1 mark]

.....

.....

4 (b) (iii) A company made magnesium using this reaction.

Calculate the mass of magnesium oxide needed to produce 1.2 tonnes of magnesium.

Relative atomic masses (A_r): O = 16; Mg = 24

[3 marks]

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Mass of magnesium oxide needed = ... tonnes

4 (b) (iv) The company calculated that they would produce 1.2 tonnes of magnesium, but only 0.9 tonnes was produced.

Calculate the percentage yield.

[1 mark]

.....

.....

Percentage yield = ... %

4 (b) (v) Give **one** reason why the calculated yield of magnesium might not be obtained.

[1 mark]

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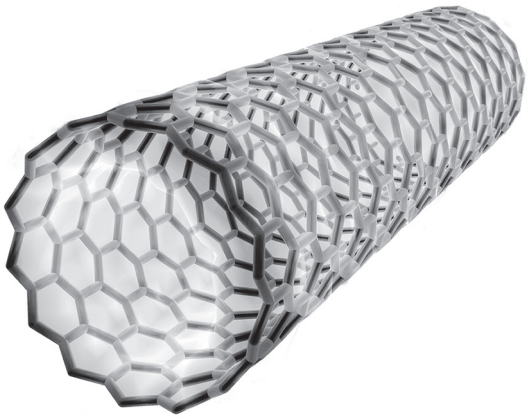
12

Turn over for the next question

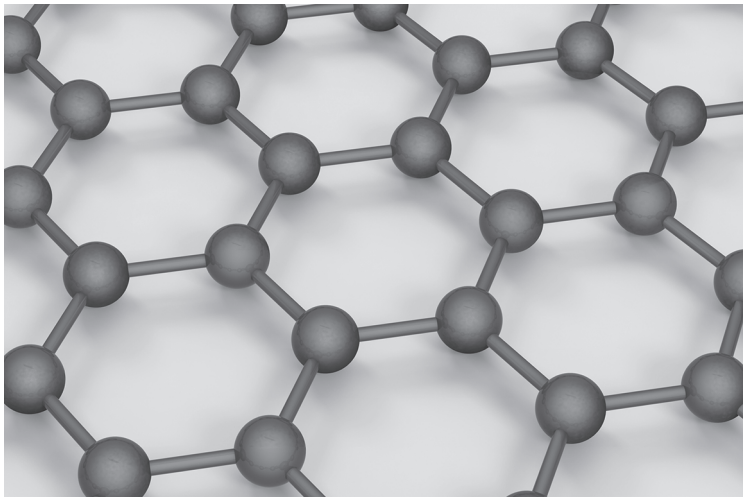
5 Carbon atoms are used to make nanotubes.



Carbon atoms in a nanotube are bonded like a single layer of graphite.

Figure 5 shows the structure of a single layer of graphite.

Figure 5



5 (a) Suggest why carbon nanotubes are used as lubricants.

[2 marks]

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5 (b) Explain why graphite can conduct electricity.

[2 marks]

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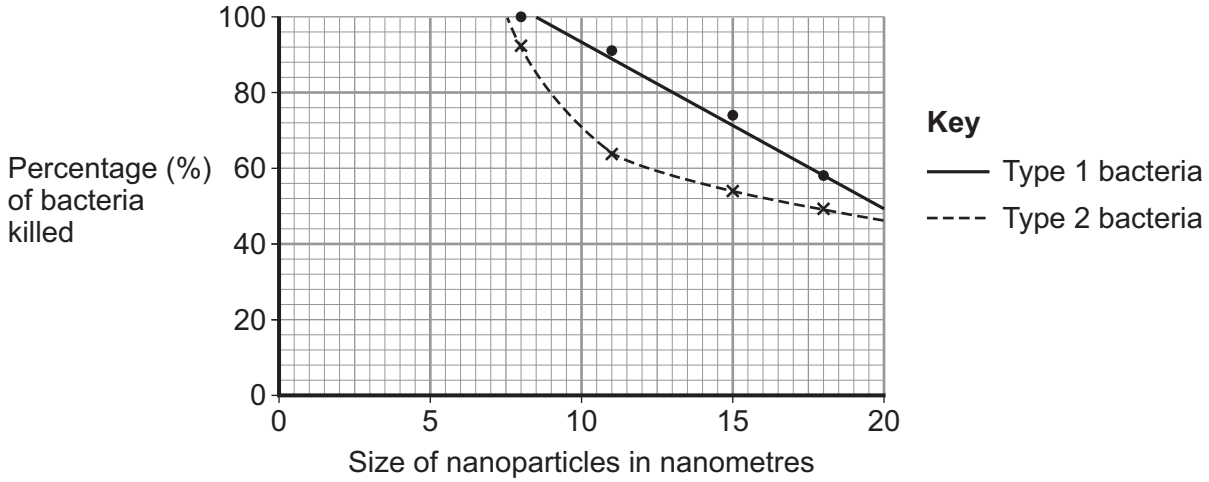
4

Turn over for the next question

6 Magnesium oxide nanoparticles can kill bacteria.

Figure 6 shows the percentage of bacteria killed by different sized nanoparticles.

Figure 6



6 (a) (i) Give **two** conclusions that can be made from **Figure 6**.

[2 marks]

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6 (a) (ii) Points are plotted for only some sizes of nanoparticles.

Would collecting and plotting data for more sizes of nanoparticles improve the conclusions?

Give a reason for your answer.

[1 mark]

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6 (b) Magnesium oxide contains magnesium ions (Mg^{2+}) and oxide ions (O^{2-}).

Describe, as fully as you can, what happens when magnesium atoms react with oxygen atoms to produce magnesium oxide.

[4 marks]

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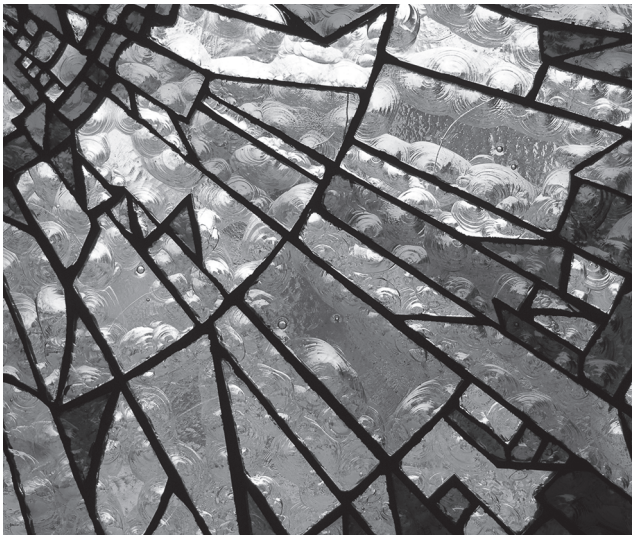
Turn over for the next question

7 Glass is made from silicon dioxide.



7 (a) Silicon dioxide has a very high melting point.

Other substances are added to silicon dioxide to make glass. Glass melts at a lower temperature than silicon dioxide.

Suggest why.

[1 mark]

.....

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7 (b) Sodium oxide is one of the substances added to silicon dioxide to make glass.

7 (b) (i) Sodium oxide contains Na^+ ions and O^{2-} ions.

Give the formula of sodium oxide.

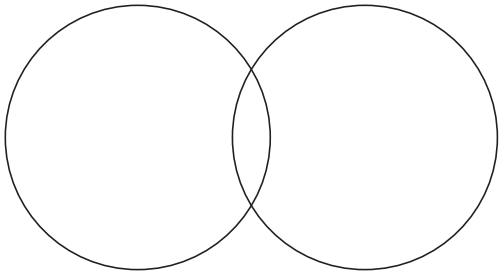
[1 mark]

.....

7 (b) (ii) Sodium oxide is made by heating sodium metal in oxygen gas.

Complete the diagram to show the outer electrons in an oxygen molecule (O_2).

[2 marks]



7 (c) Glass can be coloured using tiny particles of gold. Gold is a metal.

Describe the structure of a metal.

[3 marks]

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7

END OF QUESTIONS

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