

Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

GCSE CHEMISTRY

H

Higher Tier Paper 1

Thursday 17 May 2018

Morning

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information

- There are 100 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



0	1
---	---

Soluble salts are formed by reacting metal oxides with acids.

0	1	.	1
---	---	---	---

Give **one** other type of substance that can react with an acid to form a soluble salt.

[1 mark]

0	1	.	2
---	---	---	---

Calcium nitrate contains the ions Ca^{2+} and NO_3^-

Give the formula of calcium nitrate.

[1 mark]

0	1	.	3
---	---	---	---

Describe a method to make pure, dry crystals of magnesium sulfate from a metal oxide and a dilute acid.

[6 marks]



*Do not write
outside the
box*

8

Turn over for the next question

Turn over ►

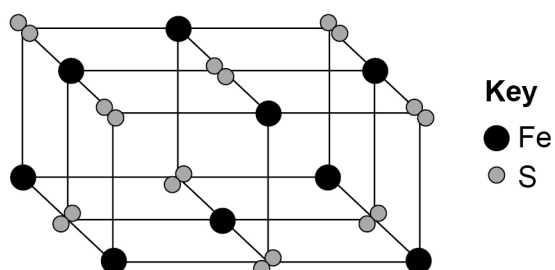


0 2

This question is about metals and metal compounds.

0 2 . 1

Iron pyrites is an ionic compound.

Figure 1 shows a structure for iron pyrites.**Figure 1**

Determine the formula of iron pyrites.

Use **Figure 1**.**[1 mark]**

0 2 . 2

An atom of iron is represented as $^{56}_{26}\text{Fe}$

Give the number of protons, neutrons and electrons in this atom of iron.

[3 marks]

Number of protons _____

Number of neutrons _____

Number of electrons _____

0 2 . 3

Iron is a transition metal.

Sodium is a Group 1 metal.

Give **two** differences between the properties of iron and sodium.**[2 marks]**

1 _____

2 _____



Nickel is extracted from nickel oxide by reduction with carbon.

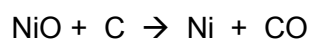
0 2 . 4

Explain why carbon can be used to extract nickel from nickel oxide.

[2 marks]

0 2 . 5

An equation for the reaction is:



Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses (A_r): C = 12 Ni = 59

Relative formula mass (M_r): NiO = 75

Give your answer to 3 significant figures.

[3 marks]

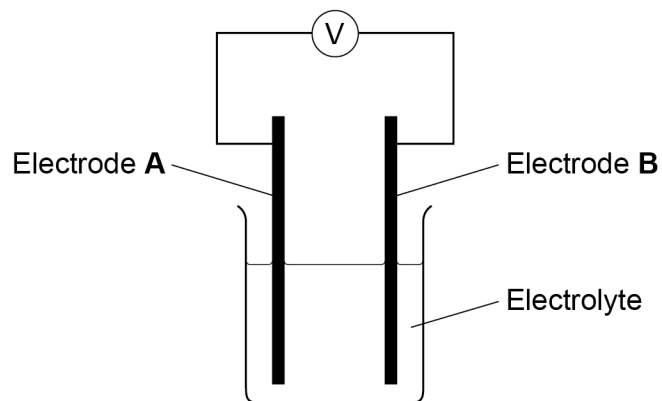
Percentage atom economy = _____ %



0 3

Chemical reactions can produce electricity.

0 3 . 1

Figure 2 shows a simple cell.**Figure 2**

Which of these combinations would **not** give a zero reading on the voltmeter in **Figure 2**?

[1 mark]Tick **one** box.

Electrode A	Electrode B	Electrolyte	
Copper	Copper	Sodium chloride solution	☐
Zinc	Zinc	Water	☐
Copper	Zinc	Sodium chloride solution	☐
Copper	Zinc	Water	☐



Alkaline batteries are non-rechargeable.

0 3 . 2 Why do alkaline batteries eventually stop working?

[1 mark]

0 3 . 3 Why can alkaline batteries **not** be recharged?

[1 mark]

Question 3 continues on the next page

Turn over ►



Hydrogen fuel cells and rechargeable lithium-ion batteries can be used to power electric cars.

0 3 . 4

Complete the balanced equation for the overall reaction in a hydrogen fuel cell.

[2 marks]



0 3 . 5

Table 1 shows data about different ways to power electric cars.

Table 1

	Hydrogen fuel cell	Rechargeable lithium-ion battery
Time taken to refuel or recharge in minutes	5	30
Distance travelled before refuelling or recharging in miles	Up to 415	Up to 240
Distance travelled per unit of energy in km	22	66
Cost of refuelling or recharging in £	50	3
Minimum cost of car in £	60 000	18 000

Evaluate the use of hydrogen fuel cells compared with rechargeable lithium-ion batteries to power electric cars.

Use **Table 1** and your own knowledge.

[6 marks]

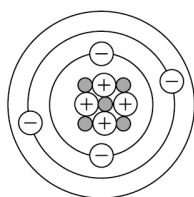


11

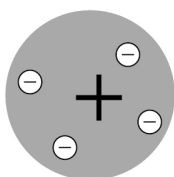
0 4

Figure 3 represents different models of the atom.

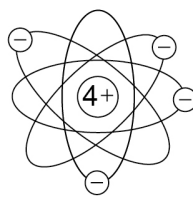
Figure 3



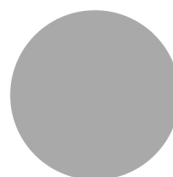
A



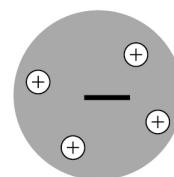
B



C



D



E

0 4 . 1

Which diagram shows the plum pudding model of the atom?

[1 mark]

Tick **one** box.

A	
---	--

B	
---	--

C	
---	--

D	
---	--

E	
---	--

0 4 . 2

Which diagram shows the model of the atom developed from the alpha particle scattering experiment?

[1 mark]

Tick **one** box.

A	
---	--

B	
---	--

C	
---	--

D	
---	--

E	
---	--

0 4 . 3

Which diagram shows the model of the atom resulting from Bohr's work?

[1 mark]

Tick **one** box.

A	
---	--

B	
---	--

C	
---	--

D	
---	--

E	
---	--



0 4 . 4 Define the mass number of an atom.

[1 mark]

0 4 . 5 Element **X** has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of ^{69}X
- 40% of ^{71}X

Estimate the relative atomic mass of element **X**.

[1 mark]

Tick **one** box.

< 69.5

☐

Between 69.5 and 70.0

☐

Between 70.0 and 70.5

☐

> 70.5

☐

0 4 . 6 Chadwick's experimental work on the atom led to a better understanding of isotopes.

Explain how his work led to this understanding.

[3 marks]



0 5

A student investigated the temperature change in displacement reactions between metals and copper sulfate solution.

Table 2 shows the student's results.

Table 2

Metal	Temperature increase in °C
Copper	0
Iron	13
Magnesium	43
Zinc	17

0 5

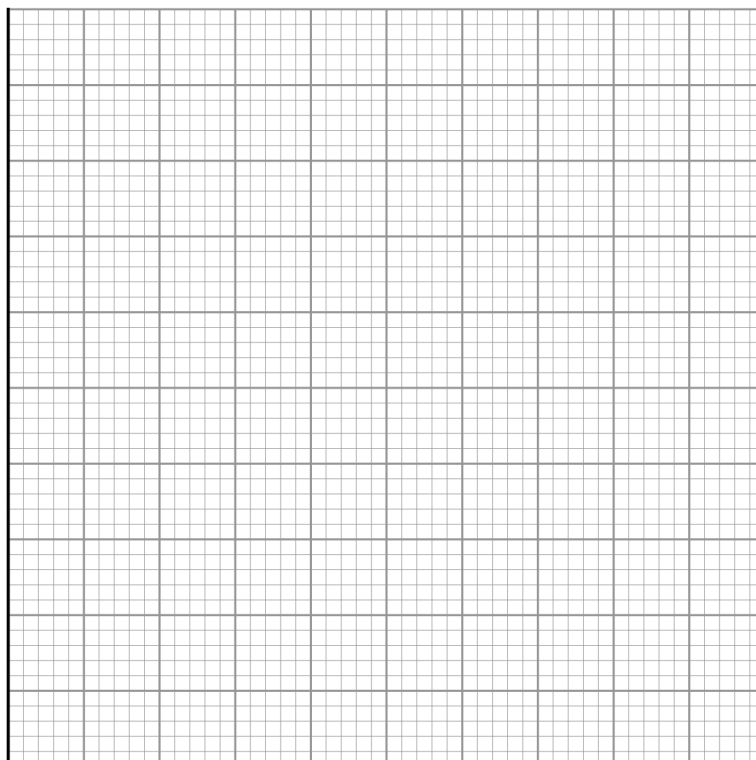
. 1

Plot the data from **Table 2** on **Figure 4** as a bar chart.

[2 marks]

Figure 4

Temperature
increase
in °C



Metal



0 5 . 2

The student concluded that the reactions between the metals and copper sulfate solution are endothermic.

Give **one** reason why this conclusion is **not** correct.

[1 mark]

0 5 . 3

The temperature change depends on the reactivity of the metal.

The student's results are used to place copper, iron, magnesium and zinc in order of their reactivity.

Describe a method to find the position of an unknown metal in this reactivity series.

Your method should give valid results.

[4 marks]

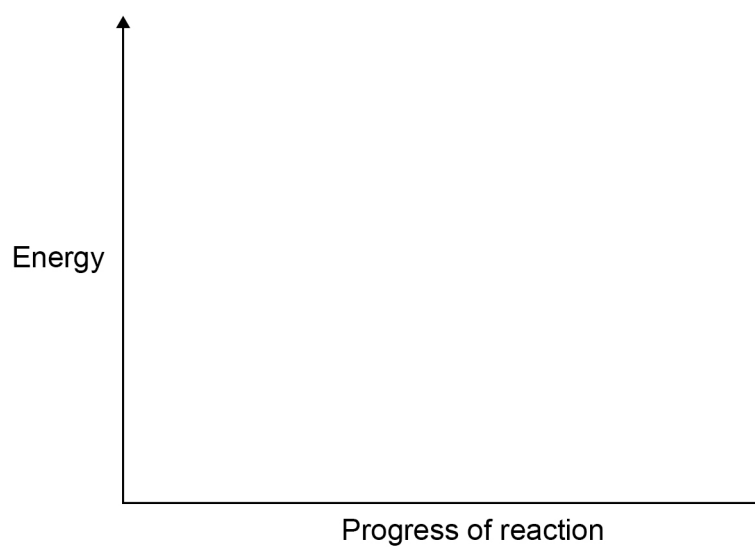
Question 5 continues on the next page

Turn over ►



0 5 . 4

Draw a fully labelled reaction profile for the reaction between zinc and copper sulfate solution on **Figure 5**.

[3 marks]**Figure 5**

10

There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►

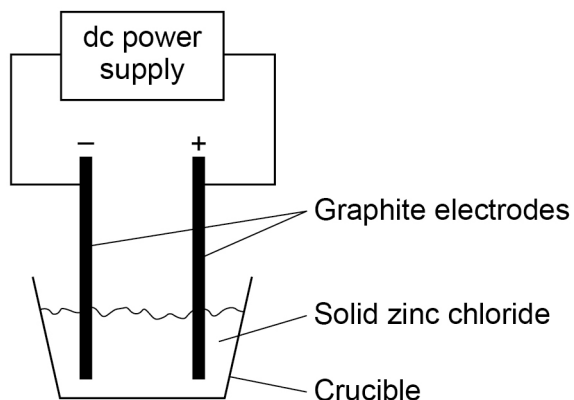


0 6

A student investigated the electrolysis of different substances.

Figure 6 shows the apparatus.

Figure 6

**0 6 . 1**

Explain why electrolysis would **not** take place in the apparatus shown in **Figure 6**.

[2 marks]

0 6 . 2

Explain why graphite conducts electricity.

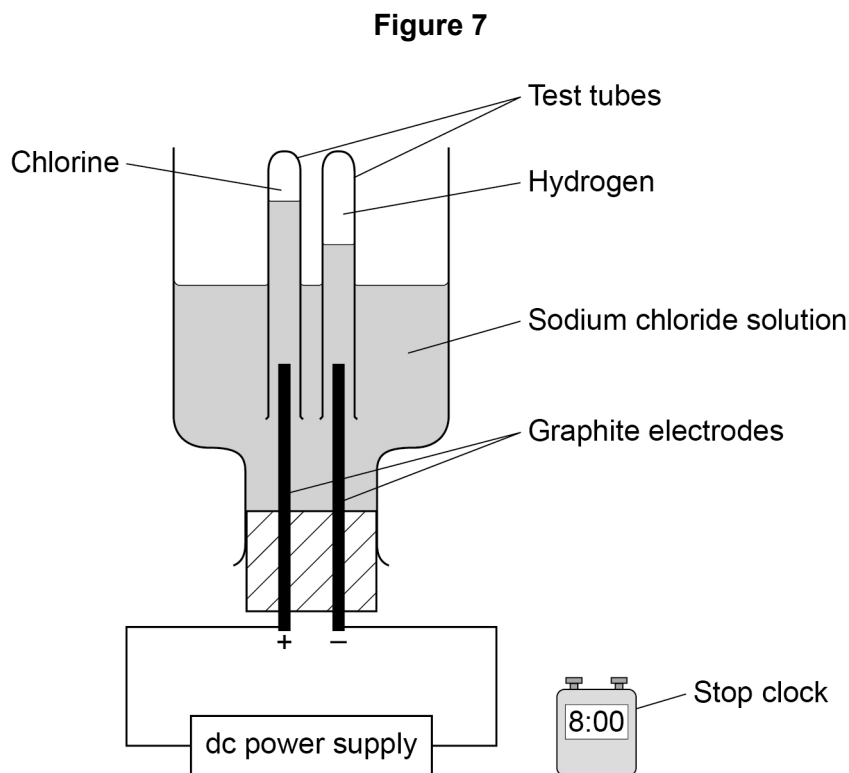
Answer in terms of the structure and bonding in graphite.

[3 marks]



The student investigated how the volume of gases produced changes with time in the electrolysis of sodium chloride solution.

Figure 7 shows the apparatus.



0 6 . 3 The student made an error in selecting the apparatus for this investigation.

How should the apparatus be changed?

Give **one** reason for your answer.

[2 marks]

Turn over ►

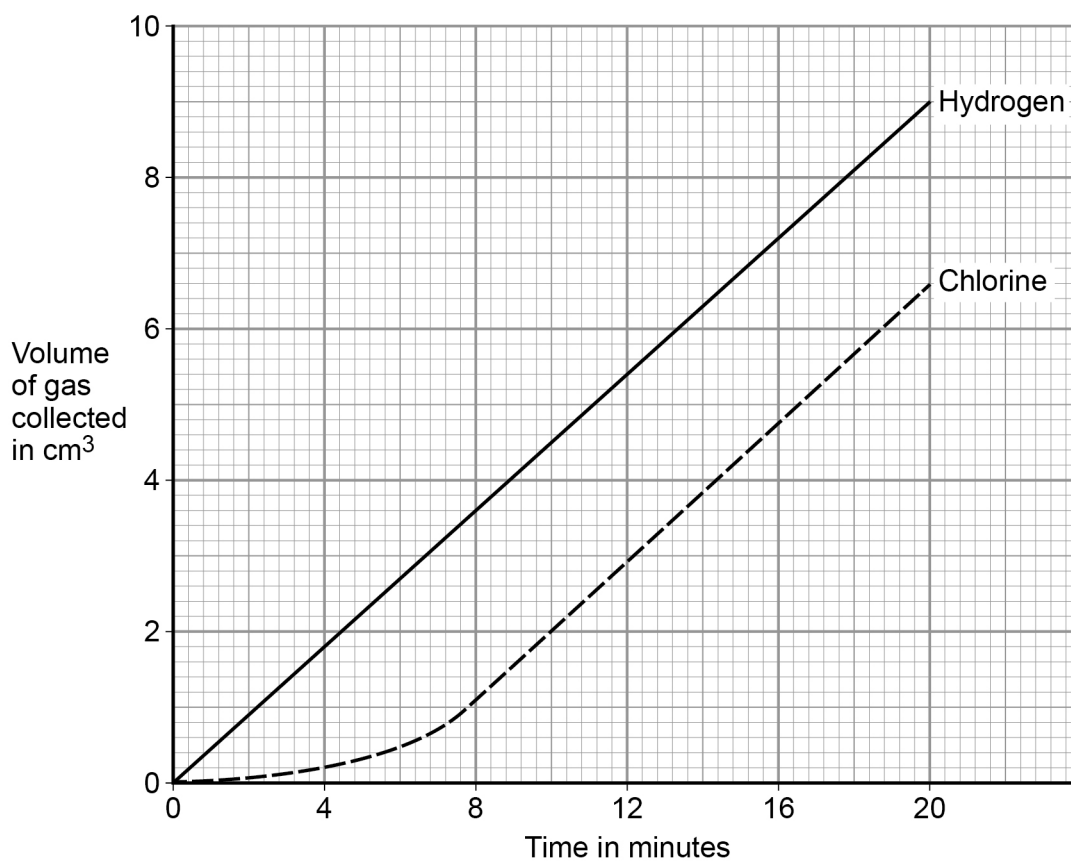


Another student used the correct apparatus.

This student measured the volumes of gases collected every minute for 20 minutes.

Figure 8 shows the student's results.

Figure 8



0 6 . 4 Describe the trends shown in the results.

Use values from **Figure 8**.

[3 marks]



0 6 . 5

The number of moles of each gas produced at the electrodes is the same.

No gas escapes from the apparatus.

Suggest **one** reason for the difference in volume of each gas collected.

[1 mark]

0 6 . 6

Calculate the amount in moles of chlorine collected after 20 minutes.

Use **Figure 8**.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Give your answer in standard form.

[3 marks]

Moles of chlorine = _____ mol

Turn over for the next question

14

Turn over ►



0 7

This question is about Group 7 elements.

Chlorine is more reactive than iodine.

0 7 . 1

Name the products formed when chlorine solution reacts with potassium iodide solution.

[1 mark]

0 7 . 2

Explain why chlorine is more reactive than iodine.

[3 marks]

0 7 . 3

Chlorine reacts with hydrogen to form hydrogen chloride.

Explain why hydrogen chloride is a gas at room temperature.

Answer in terms of structure and bonding.

[3 marks]



0 7 . 4 Bromine reacts with methane in sunlight.

Figure 9 shows the displayed formulae for the reaction of bromine with methane.

Figure 9

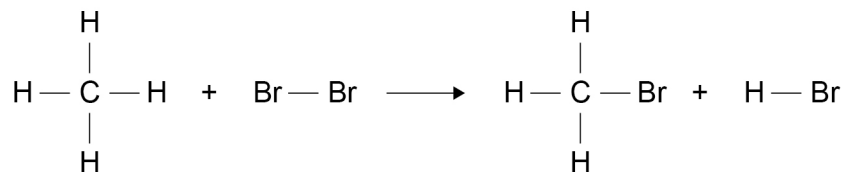


Table 3 shows the bond energies and the overall energy change in the reaction.

Table 3

	C—H	Br—Br	C—Br	H—Br	Overall energy change
Energy in kJ/mol	412	193	X	366	– 51

Calculate the bond energy **X** for the C—Br bond.

Use **Figure 9** and **Table 3**.

[4 marks]

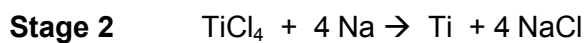
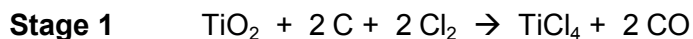
Bond energy **X** = _____ kJ/mol



0	8
---	---

Titanium is a transition metal.

Titanium is extracted from titanium dioxide in a two stage industrial process.



0	8	.	1
---	---	---	---

Suggest **one** hazard associated with **Stage 1**.

[1 mark]

0	8	.	2
---	---	---	---

Water must be kept away from the reaction in **Stage 2**.

Give **one** reason why it would be hazardous if water came into contact with sodium.

[1 mark]

0	8	.	3
---	---	---	---

Suggest why the reaction in **Stage 2** is carried out in an atmosphere of argon and **not** in air.

[2 marks]



0 8 . 4 Titanium chloride is a liquid at room temperature.

Explain why you would **not** expect titanium chloride to be a liquid at room temperature.

[3 marks]

In **Stage 2**, sodium displaces titanium from titanium chloride.

0 8 . 5 Sodium atoms are oxidised to sodium ions in this reaction.

Why is this an oxidation reaction?

[1 mark]

0 8 . 6 Complete the half equation for the oxidation reaction.

[1 mark]

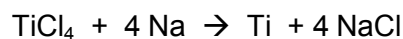


Turn over ►



0 8 . 7 In **Stage 2**, 40 kg of titanium chloride was added to 20 kg of sodium.

The equation for the reaction is:



Relative atomic masses (A_r): Na = 23 Cl = 35.5 Ti = 48

Explain why titanium chloride is the limiting reactant.

You **must** show your working.

[4 marks]

0 8 . 8 For a **Stage 2** reaction the percentage yield was 92.3%

The theoretical maximum mass of titanium produced in this batch was 13.5 kg.

Calculate the actual mass of titanium produced.

[2 marks]

Mass of titanium = _____ kg



0 9

This question is about acids and alkalis.

0 9 . 1

Dilute hydrochloric acid is a strong acid.

Explain why an acid can be described as both strong and dilute.

[2 marks]

0 9 . 2A $1.0 \times 10^{-3} \text{ mol/dm}^3$ solution of hydrochloric acid has a pH of 3.0What is the pH of a $1.0 \times 10^{-5} \text{ mol/dm}^3$ solution of hydrochloric acid?**[1 mark]**

pH = _____

Question 9 continues on the next page**Turn over ►**

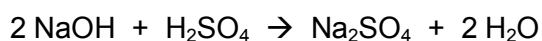
A student titrated 25.0 cm³ portions of dilute sulfuric acid with a 0.105 mol/dm³ sodium hydroxide solution.

0 9 . 3 Table 4 shows the student's results.

Table 4

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of sodium hydroxide solution in cm ³	23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:



Calculate the concentration of the sulfuric acid in mol/dm³

Use only the student's concordant results.

Concordant results are those within 0.10 cm³ of each other.

[5 marks]

Concentration of sulfuric acid = _____ mol/dm³



0 9 . 4

Explain why the student should use a pipette to measure the dilute sulfuric acid and a burette to measure the sodium hydroxide solution.

[2 marks]

0 9 . 5

Calculate the mass of sodium hydroxide in 30.0 cm^3 of a 0.105 mol/dm^3 solution.

Relative formula mass (M_r): $\text{NaOH} = 40$

[2 marks]

Mass of sodium hydroxide = _____ g

END OF QUESTIONS

12



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Copyright information

For confidentiality purposes, from the November 2015 examination series, acknowledgements of third party copyright material will be published in a separate booklet rather than including them on the examination paper or support materials. This booklet is published after each examination series and is available for free download from www.aqa.org.uk after the live examination series.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team, AQA, Stag Hill House, Guildford, GU2 7XJ.

Copyright © 2018 AQA and its licensors. All rights reserved.

