A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: TRILOGY

H

Higher Tier

Chemistry Paper 1H

8464/C/1H

Thursday 16 May 2019 Morning

Time allowed: 1 hour 15 minutes

For this paper you must have:
- **a ruler**
- **a scientific calculator**
- **the periodic table (enclosed).**

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

J U N 1 9 8 4 6 4 C 1 H 0 1

BLANK PAGE

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **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

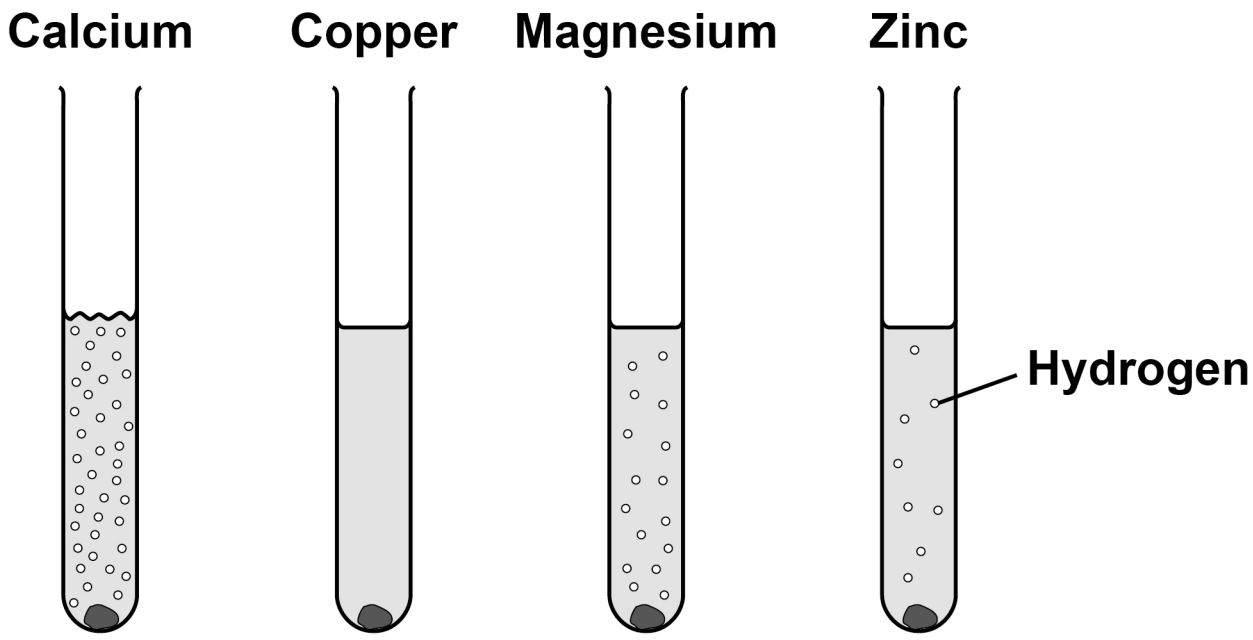
- **The maximum mark for this paper is 70.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1 **This question is about reactions of metals.**

FIGURE 1 shows what happens when calcium, copper, magnesium and zinc are added to hydrochloric acid.

FIGURE 1



0 1 . 1 What is the order of decreasing reactivity of these four metals? [1 mark]

Tick (✓) ONE box.

- ☐ **Zn Ca Cu Mg**
- ☐ **Ca Cu Mg Zn**
- ☐ **Cu Zn Ca Mg**
- ☐ **Ca Mg Zn Cu**

[Turn over]

A student wants to make a fair comparison of the reactivity of the metals with hydrochloric acid.

0 1 . 2 **Name TWO variables that must be kept constant. [2 marks]**

1 _____

_____

_____

2 _____

_____

_____

0 1 . 3 **What is the independent variable in this reaction? [1 mark]**

_____

_____

_____

0 1 . 4 **Predict the reactivity of beryllium compared with magnesium.**

Give a reason for your answer.

Use the periodic table. [2 marks]

_____

_____

Reason _____

_____

_____

_____

_____

[Turn over]

0 1 . 5 **A solution of hydrochloric acid contains 3.2 g of hydrogen chloride in 50 cm^3**

Calculate the concentration of hydrogen chloride in g per dm^3 [3 marks]

Concentration = _____ g per dm^3

9

BLANK PAGE

[Turn over]

0 2 **This question is about salts.**

Ammonium nitrate solution is produced when ammonia gas reacts with nitric acid.

0 2 . 1 **Give the state symbol for ammonium nitrate solution. [1 mark]**

_____

0 2 . 2 **What is the formula of nitric acid? [1 mark]**

Tick (✓) ONE box.

☐ **HCl**

☐ **HNO_3**

☐ **H_2SO_4**

☐ **NH_4OH**

0 2 . 3 **Ammonia gas dissolves in water to produce ammonia solution.**

Ammonia solution contains hydroxide ions, OH^-

A student adds universal indicator to solutions of nitric acid and ammonia.

What colour is observed in each solution? [2 marks]

Colour in nitric acid

_____

Colour in ammonia solution

_____

[Turn over]

0 2 . 4 **The student gradually added nitric acid to ammonia solution.**

Which row, A, B, C or D, shows the change in pH as the nitric acid is added until in excess? [1 mark]

Tick (✓) ONE box.

		pH of ammonia solution at start	pH after addition of excess nitric acid
☐	A	10	7
☐	B	2	10
☐	C	7	1
☐	D	10	2

0 2 . 5 **Calculate the percentage by mass of oxygen in ammonium nitrate (NH_4NO_3).**

Relative atomic masses (A_r):
H = 1 N = 14 O = 16

Relative formula mass (M_r): NH_4NO_3 = 80
[3 marks]

Percentage by mass of oxygen = _____ %

0 2 . 6 **Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.**

You do NOT need to write about safety precautions. [6 marks]

0 3 **This question is about oxygen.**

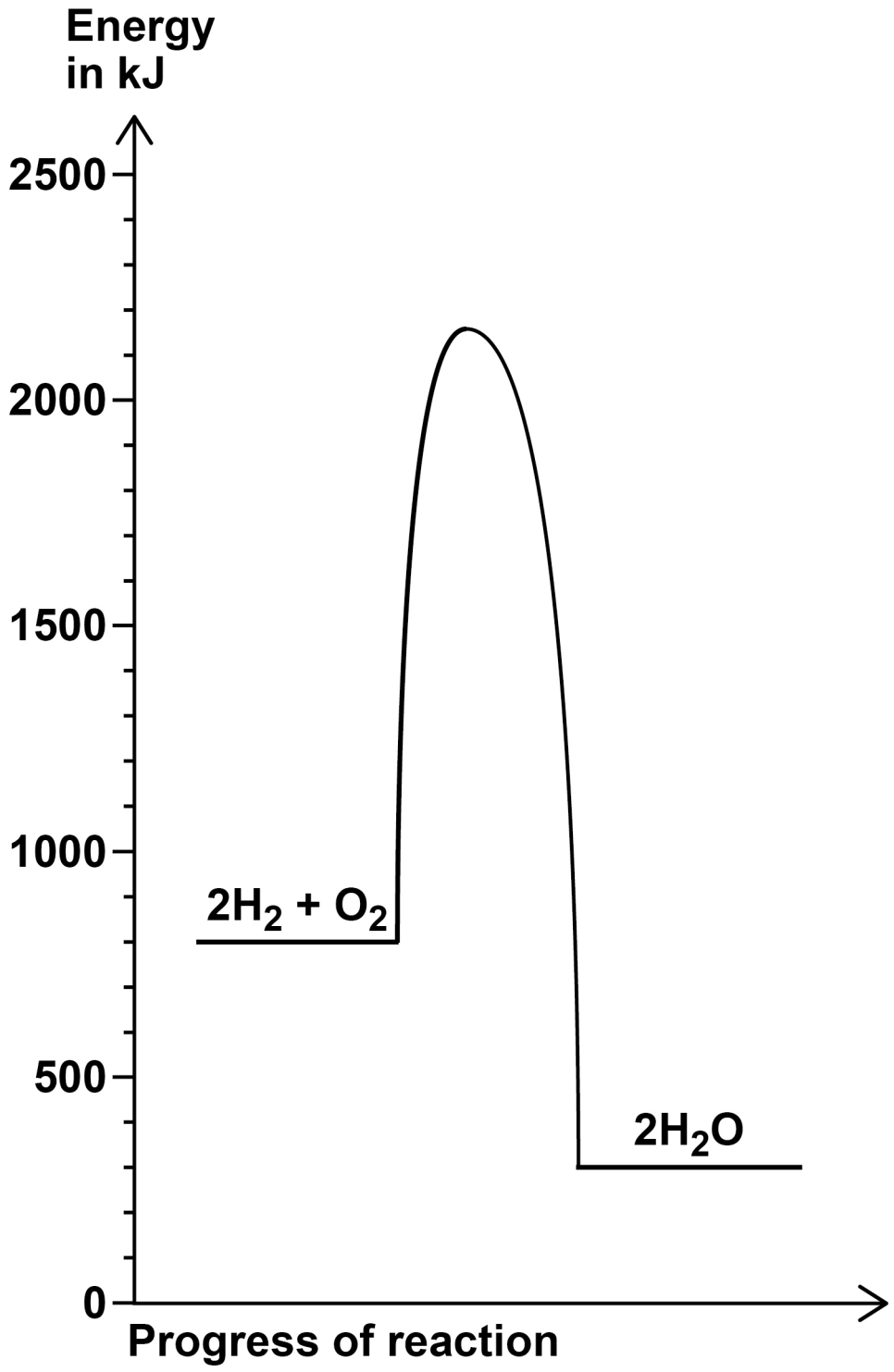
0 3 . 1 **Hydrogen reacts with oxygen.**

$$2\ H_2\ (g)\ +\ O_2\ (g)\ \rightarrow\ 2\ H_2O\ (g)$$

FIGURE 2 shows the relative energies of the reactants and products at a certain temperature.

Label the activation energy on FIGURE 2.
[1 mark]

FIGURE 2


Energy
in kJ
2500
2000
1500
1000
500
0
$2H_2 + O_2$
$2H_2O$
Progress of reaction

BLANK PAGE

0 3 . 2 **Determine the overall energy change for the reaction between hydrogen and oxygen shown in Question 03.1**

Use FIGURE 2 on page 17. [2 marks]

Energy change = _____ kJ

[Turn over]

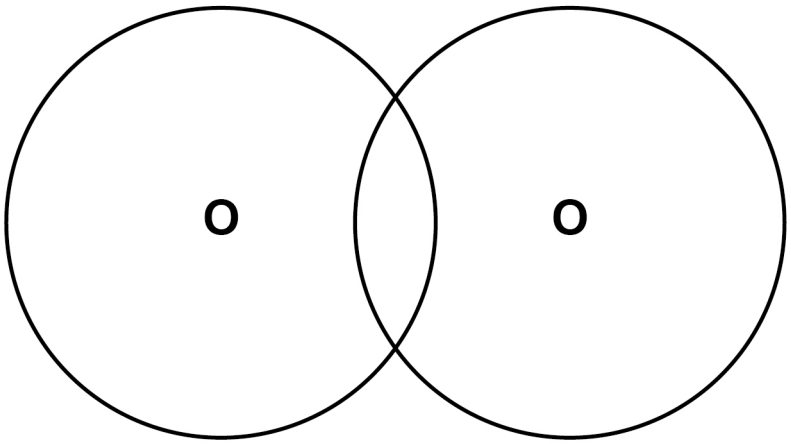
BLANK PAGE

0 3 . 3 **Oxygen is in Group 6 of the periodic table.**

FIGURE 3 shows the outer energy levels in one molecule of oxygen (O_2).

Draw the electrons in the outer energy levels in FIGURE 3. [2 marks]

FIGURE 3



0 3 . 4 **The equation shows the decomposition of hydrogen peroxide.**

TABLE 1 shows the bond energies.

TABLE 1

Bond	O–O	O=O	O–H
Bond dissociation energy in kJ per mole	138	496	463

Calculate the overall energy change for the reaction. [3 marks]

Energy change = _____ kJ

8

0 4 **This question is about elements in the periodic table.**

0 4 . 1 **What order did scientists use to arrange elements in early periodic tables? [1 mark]**

0 4 . 2 **In the early periodic tables some elements were placed in the wrong groups.**

Mendeleev overcame this in his periodic table.

Give ONE way Mendeleev did this. [1 mark]

TABLE 2 shows the boiling points of fluorine, chlorine and bromine.

TABLE 2

Element	Boiling point in °C
Fluorine	–186
Chlorine	–34
Bromine	+59

0 4 . 3 **Explain why the boiling points in TABLE 2 are low. [2 marks]**

0 4 . 4 **Explain the trend in the boiling points in TABLE 2 on page 25. [3 marks]**

0 4 . 5 **Explain why neon is unreactive.**

Give the electronic structure of neon in your answer. [2 marks]

0 4 . 6 How many atoms are there in 1 g of argon?

The Avogadro constant is 6.02×10^{23} per mole.

Relative atomic mass (A_r): Ar = 40

[2 marks]

Number of atoms in 1 g = _____

11

0 5 **This question is about electrolysis.**

0 5 . 1 **Some metals are extracted from molten compounds using electrolysis.**

Why is electrolysis used to extract some metals? [1 mark]

_____

_____

_____

0 5 . 2 **Aluminium is produced by electrolysis of a molten mixture.**

What TWO substances does the molten mixture contain? [2 marks]

1 _____

_____

2 _____

_____

0 5 . 3 **Copper and chlorine are produced when molten copper chloride is electrolysed.**

Complete the half equation for the reaction at each electrode. [2 marks]

Half equation at negative electrode

Cu^{2+} _____ → _____

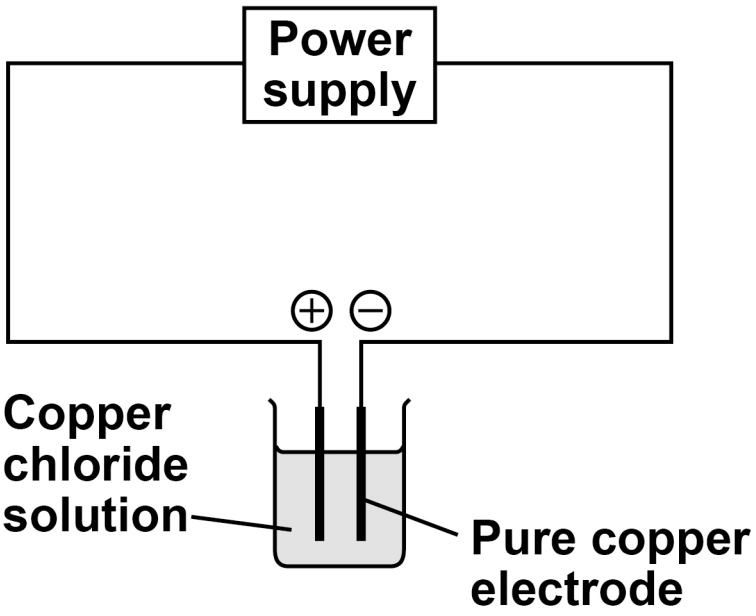
Half equation at positive electrode

$2\ Cl^{-}$ → _____

[Turn over]

FIGURE 4 shows the apparatus a student used to electrolyse copper chloride solution.

FIGURE 4



The student:

- **measured the mass of copper deposited on the negative electrode after 60 minutes**
- **compared the mass deposited with the expected value.**

0 5 . 4 **Suggest TWO reasons why the mass deposited was different from the expected value. [2 marks]**

1 _____

_____

_____

2 _____

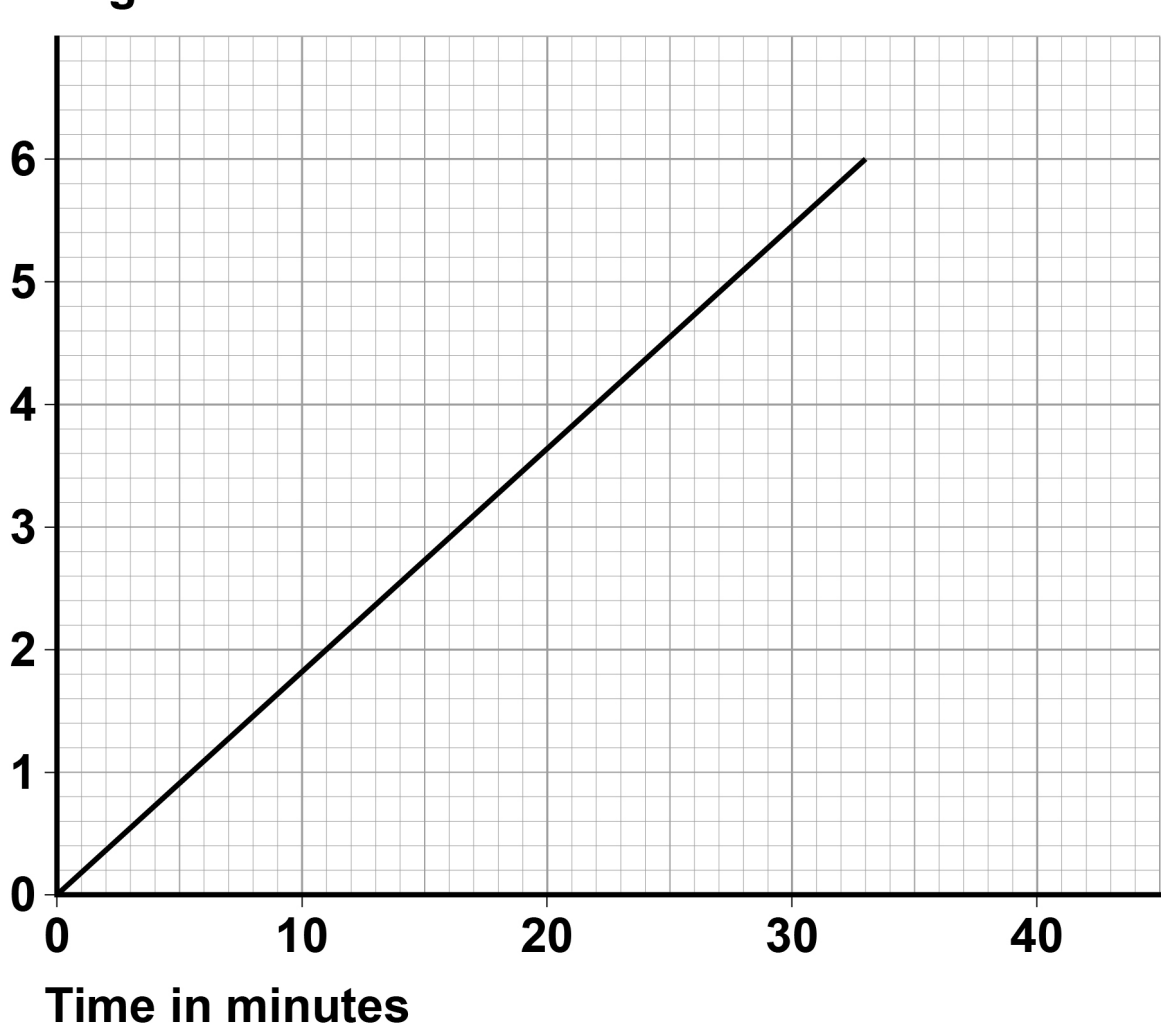
_____

_____

[Turn over]

0 5 . 5 **FIGURE 5 shows the expected mass of copper produced each minute.**

FIGURE 5



Determine the expected mass of copper after 24 hours.

Use FIGURE 5. [3 marks]

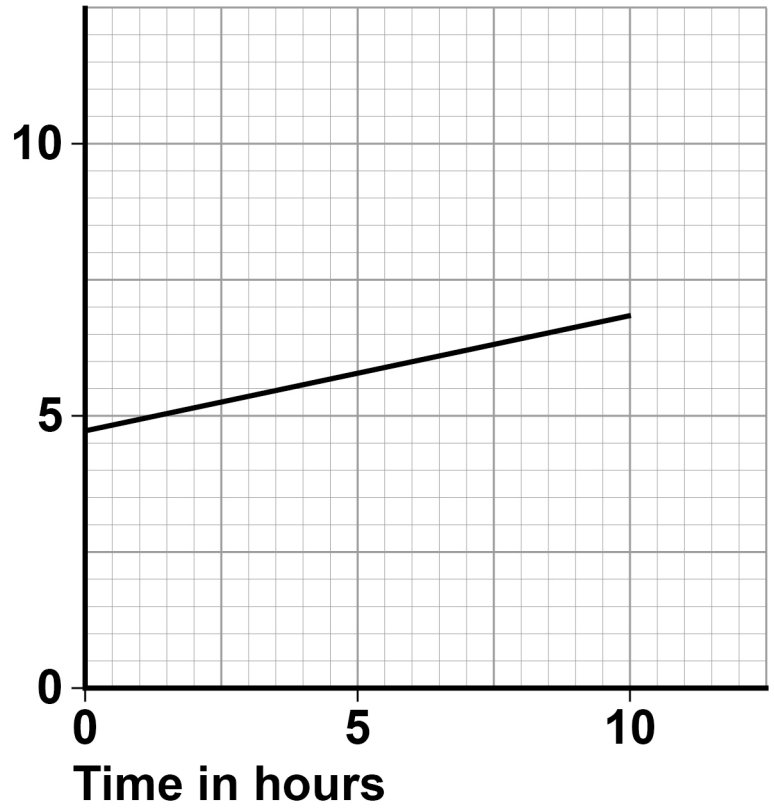
Mass = _____ mg

[Turn over]

Silver nitrate solution is electrolysed.

FIGURE 6 shows the change in mass of the negative electrode over 10 hours.

FIGURE 6



0 5 . 6 Determine the mass of the negative electrode at the start of the experiment.

Use FIGURE 6. [1 mark]

0 5 . 7 **Calculate the gradient of the line in FIGURE 6.**

Give the unit. [3 marks]

Gradient _____

Unit _____

14

0 6 **This question is about sodium.**

0 6 . 1 **Sodium reacts with chlorine.**

What is the balanced equation for the reaction? [1 mark]

Tick (✓) ONE box.

☐ $Na + Cl \rightarrow NaCl$

☐ $Na + Cl_2 \rightarrow NaCl_2$

☐ $2\,Na + Cl_2 \rightarrow 2\,NaCl$

☐ $2\,Na + Cl \rightarrow Na_2Cl$

0 6 . 2 **Hot sodium is put in a gas jar of chlorine.**

Describe the observations made before, during and after the reaction. [3 marks]

Before reaction _____

_____

_____

During reaction _____

_____

_____

After reaction _____

_____

_____

[Turn over]

0 6 . 3 **Explain why sodium is less reactive than potassium. [4 marks]**

0 6 . 4 **Chlorine reacts with sodium and with hydrogen.**

Compare the structure and bonding in sodium chloride and hydrogen chloride. [6 marks]

14

END OF QUESTIONS

BLANK PAGE

BLANK PAGE

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

Copyright information

For confidentiality purposes, from the November 2015 examination series, acknowledgements of third-party copyright material are 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 © 2019 AQA and its licensors. All rights reserved.