AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 1H

Thursday 16 May 2019 Morning Time allowed: 1 hour 15 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.

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

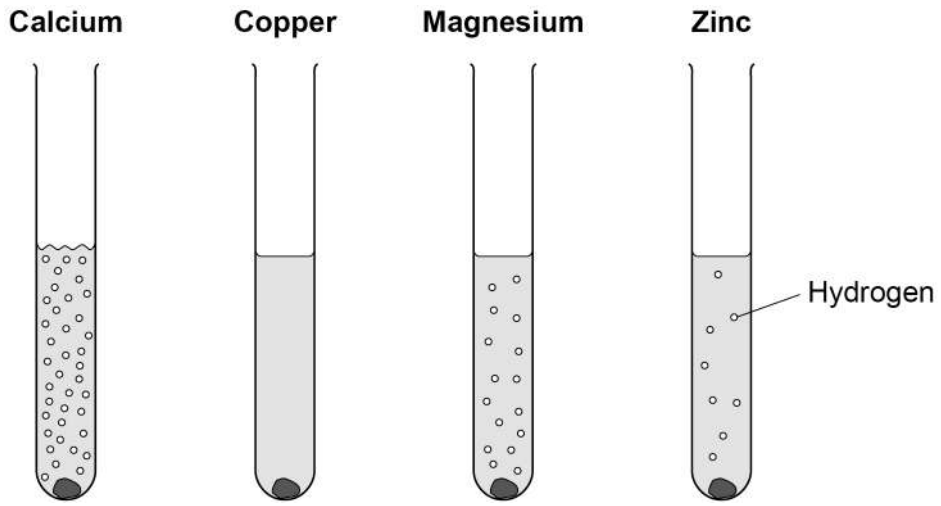
Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

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 ☑

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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 mass (of metal / element)

2 • surface area (of metal / element)

0 1 . 3 What is the independent variable in this reaction?

[1 mark]

type of) metal / element

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

Give a reason for your answer.

Use the periodic table.

[2 marks]

(beryllium is) less reactive

Reason • greater attraction between nucleus and outer electrons

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]

$\frac{50}{1000}$ (dm3)

= 0.05 (dm3)

$(\frac{3.2}{0.05})$

Concentration = 64 g per dm^3

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Turn over ►

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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]

aq

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: red

Colour in ammonia solution: purple or blue

Do not write outside the box

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]

3 × 16 or 48

$\frac{48}{80}$ ×100)

Percentage by mass of oxygen = _____ %

Question 2 continues on the next page

Do not write outside the box

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]

Indicative content

Steps

- use a suitable container eg test tube
- use insulation
- add water
- measure the initial water temperature (with a thermometer)
- add stated mass eg 1g or 1 spatula
- stir (to dissolve the solid)
- measure the final (allow lowest or highest) temperature of the solution
- calculate the temperature difference or determine graphically
- repeat with different masses
- repeat with the same volume of water

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Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

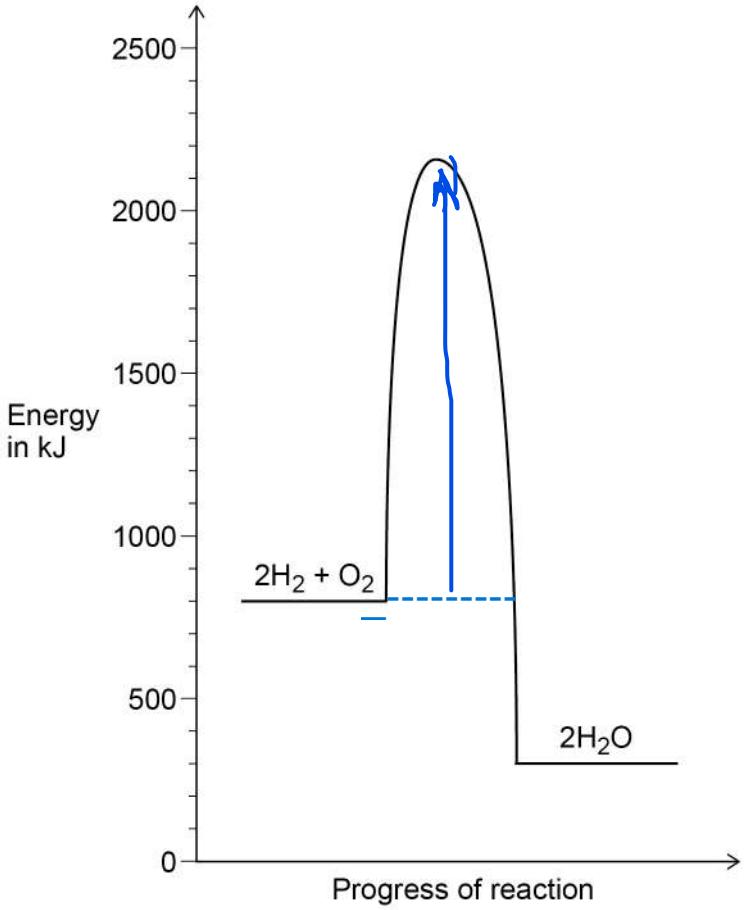
0 3 This question is about oxygen.

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.

Figure 2



Label the activation energy on **Figure 2**.

[1 mark]

Do not write outside the box

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

Use **Figure 2**.

[2 marks]

reads levels of reactants (800 kJ) and products (300 kJ)

(800 – 300)

Energy change = 500 kJ

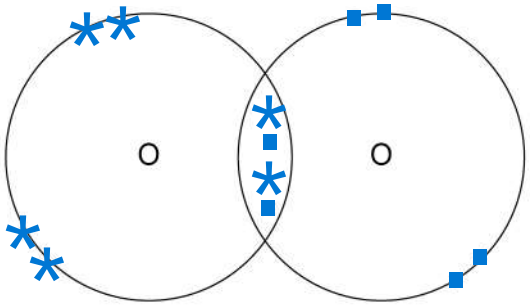
0 3 . 3 Oxygen is in Group 6 of the periodic table.

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



Question 3 continues on the next page

Do not write outside the box

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

$$2\ H{-}O{-}O{-}H \rightarrow 2\ H{-}O{-}H + O{=}O$$

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]

(bonds broken = (4×463) + (2×138) = 2128

(bonds made)

((4×463) + (496) = 2348

(energy change = bonds broken – bonds made)

(2128 – 2348

Energy change = (–) 220 kJ

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Do not write outside the box

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]

atomic weight

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]

left gaps / spaces

Question 4 continues on the next page

Do not write outside the box

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]

weak forces between the molecules
or
weak intermolecular forces

(so) little energy required to overcome / break the forces between molecules

0 4 . 4 Explain the trend in the boiling points in **Table 2**.

[3 marks]

(the) molecules get larger going down the group

(so the) forces between the molecules increase
or
(so the) intermolecular forces increase

(so the) boiling points increase going down the group

Do not write outside the box

0 4 . 5 Explain why neon is unreactive.

Give the electronic structure of neon in your answer.

[2 marks]

2,8

(so) stable arrangement of electrons

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]

$0.025 \times 6.02 \times 10^{23}$

1.51×10^{22}

Number of atoms in 1 g = 1.51×10^{22}

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Turn over for the next question

Do not write outside the box

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]

metal is too reactive to be extracted using carbon

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

What **two** substances does the molten mixture contain?

[2 marks]

1 aluminium oxide

2 cryolite

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+} _____ → _____

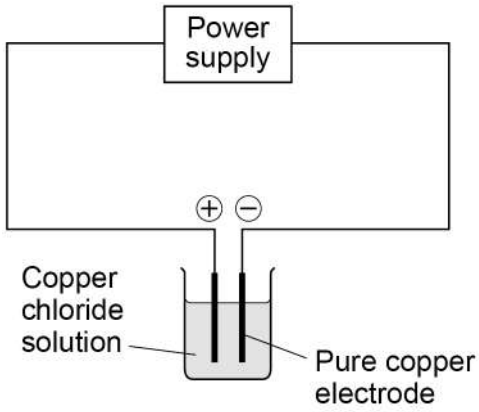
Half equation at positive electrode

$2\ Cl^{-}$ → _____

Do not write outside the box

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 concentration / volume of solution was different

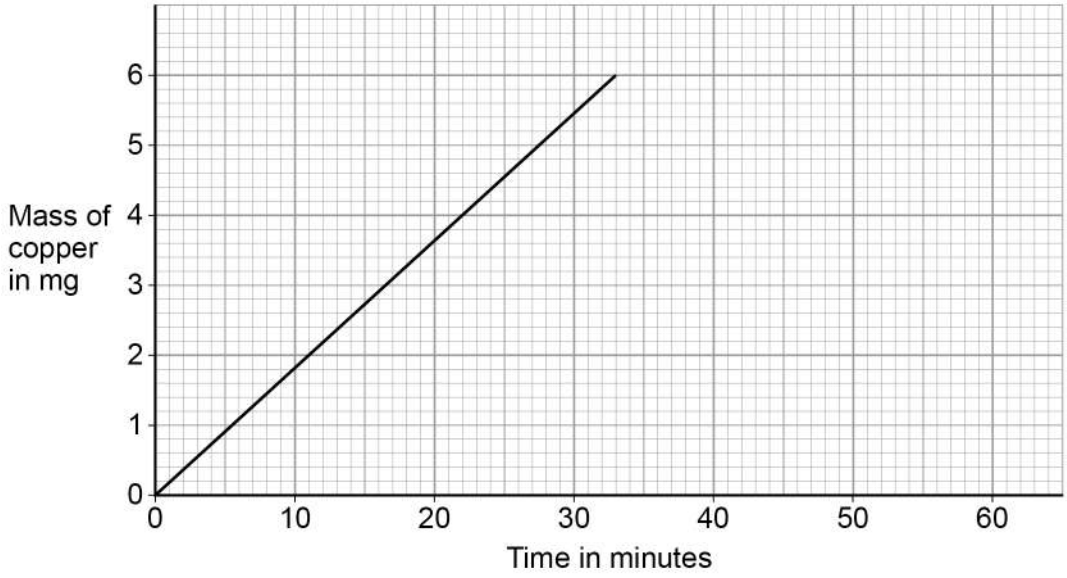
2 impurities in solution

Question 5 continues on the next page

Do not write outside the box

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]

reading of mass at stated time

factor from time to 24 hours

correct evaluation

alternative approach:

calculates the gradient (1)

gradient × time in minutes in 24 hours (1)

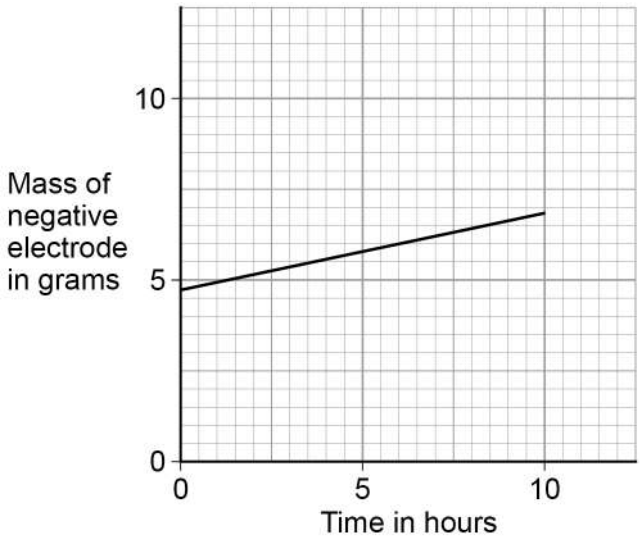
correct evaluation (1)

Mass = _____ mg

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]

4.75 (g)

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

Give the unit.

[3 marks]

(working)

Y increase and X increase measured from graph

and substitution into Y increase X increase

correct evaluation

Gradient

Unit (units) g/hour

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Do not write outside the box

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 silver solid / liquid / metal

During reaction yellow flame

After reaction white solid / powder

Do not write outside the box

0 6 . 3 Explain why sodium is less reactive than potassium.

[4 marks]

sodium has fewer energy levels / shells

outer electron / shell is closer to nucleus
or
outer electron / shell is less shielded

(so) greater attraction between nucleus and outer electron / shell

(so) outer electron is less easily lost.

Question 6 continues on the next page

Do not write outside the box

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

Compare the structure and bonding in sodium chloride and hydrogen chloride.

[6 marks]

Indicative content

sodium chloride | hydrogen chloride

differences in bonding

ionic | covalent

metal & ~~non-metal~~ two non-metals

transferring electrons | sharing electrons

ions (Na~~+ and Cl−~~) | molecules

charged particles | neutral or no overall charge

differences in structure

giant structure or lattice | small / simple / discrete molecules

electrostatic intermolecular forces

(electrostatic forces) are strong | (intermolecular forces) are weak

act in all directions | random or between the molecules

regular | ~~irregular / random~~

similarities in bonding

full shells or stability | full shells or stability

(transferring) electrons | (sharing) electrons

strong bonds | strong (covalent) bonds

similarities in structure | ~~(electrostatic)~~ forces | ~~(intermolecular)~~ forces

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END OF QUESTIONS