Please write clearly in block capitals.

H

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier Chemistry Paper 1

Practice Paper Series – Set 2

Time allowed: 1 hour 15 minutes

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (printed at the back of this booklet).

Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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 marks for questions are shown in brackets.
- The maximum mark for this paper is 70.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering question 04.6 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully developed
  - shows how the points that you make are related or follow on from each other where appropriate.

This is an original practice paper written for sciencegcse.co.uk to match the style and demand of AQA GCSE Combined Science: Trilogy (8464) Chemistry Paper 1 (Higher Tier). It is not an AQA examination paper and has not been produced or endorsed by AQA. It is not a prediction of a future examination.

0 1 Some cold packs use an endothermic reaction.

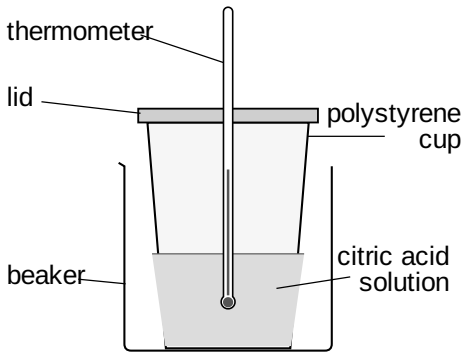
A student investigated how the mass of sodium hydrogencarbonate affects the temperature decrease when it reacts with citric acid solution.

This is the method used.

1. Pour 25 cm^3 of citric acid solution into a polystyrene cup.
2. Measure the temperature of the solution.
3. Add 1.0 g of sodium hydrogencarbonate and stir.
4. Record the lowest temperature.
5. Repeat steps 1 to 4 with fresh citric acid solution and different masses of sodium hydrogencarbonate.

Figure 1 shows the apparatus.

Figure 1



0 1 . 1 Why did the student put the citric acid solution in a polystyrene cup and not directly in a glass beaker? [1 mark]

.....

.....

Table 1 shows the results.

Table 1

Mass of sodium hydrogencarbonate in g		1.0	2.0	3.0	4.0	5.0	6.0
Temperature decrease in °C	**Trial 1**	2.1	3.8	6.1	7.9	8.6	8.8
	Trial 2	1.9	4.2	5.7	7.7	8.8	8.6
	Mean	2.0	4.0	5.9	**X**	8.7	8.7

0 1 . 2 Calculate mean **X**. [1 mark]

X = ... °C

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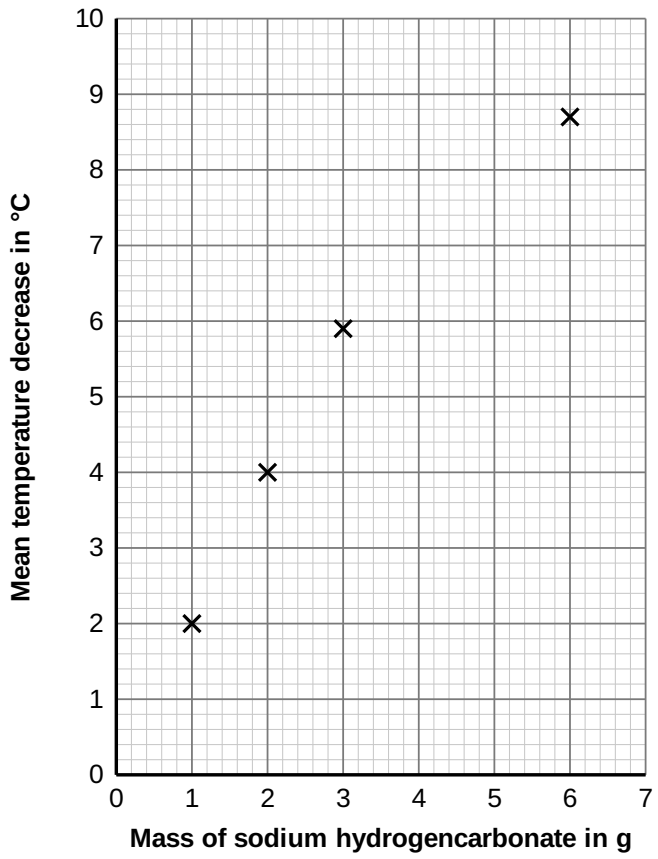
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0 1 . 3 **Figure 2** shows some of the results. [3 marks]

Complete **Figure 2**:

- plot the mean results for 4.0 g and 5.0 g
- draw a line of best fit.

Figure 2



0 1 . 4 Describe the relationship between the mass of sodium hydrogencarbonate and the temperature decrease. [2 marks]

0 1 . 5 Suggest why the temperature decrease did **not** increase when more than 5.0 g of sodium hydrogencarbonate was used. [2 marks]

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0 1 . 6 Explain why the temperature of the solution decreased. [2 marks]

Use ideas about energy.

.....

.....

.....

.....

0 2 Sodium carbonate reacts with dilute nitric acid.

0 2 . 1 Calculate the relative formula mass (M_r) of sodium carbonate, Na_2CO_3 [2 marks]

Relative atomic masses (A_r): C = 12 O = 16 Na = 23

M_r = ...

0 2 . 2 Name the salt produced when sodium carbonate reacts with nitric acid. [1 mark]

.....

0 2 . 3 Bubbles of a gas are produced. [1 mark]

Name the gas.

.....

0 2 . 4 Balance the equation for the reaction. [1 mark]

..... Na_2CO_3 + ... HNO_3 ⟶ ..... $NaNO_3$ + H_2O + CO_2

0 2 . 5 The reaction was done in an open flask on a balance. [1 mark]

Explain why the mass of the flask and its contents decreased during the reaction.

.....

.....

Question 2 continues on the next page

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0 2 . 6 A student dissolved 5.30 g of sodium carbonate in water to make 250 cm^3 of solution. [3 marks]

The student calculated the concentration of the solution like this:

concentration = 5.30 ÷ 250 = 0.0212 g/dm^3

Explain the student's mistake.

Calculate the correct concentration in g/dm^3

Concentration = _____ g/dm^3

0 3 Hydrogen reacts with chlorine to produce hydrogen chloride.

$$H–H + Cl–Cl \longrightarrow 2\ H–Cl$$

The overall energy change for the reaction is −185 kJ/mol

Table 2 shows some bond energies.

Table 2

Bond	H–H	Cl–Cl	H–Cl
Bond energy in kJ/mol	436	243	432

0 3 . 1 This reaction is exothermic. [3 marks]

Explain why, in terms of the energy needed to break bonds and the energy released when bonds form.

0 3 . 2 What is meant by the **activation energy** of a reaction? [1 mark]

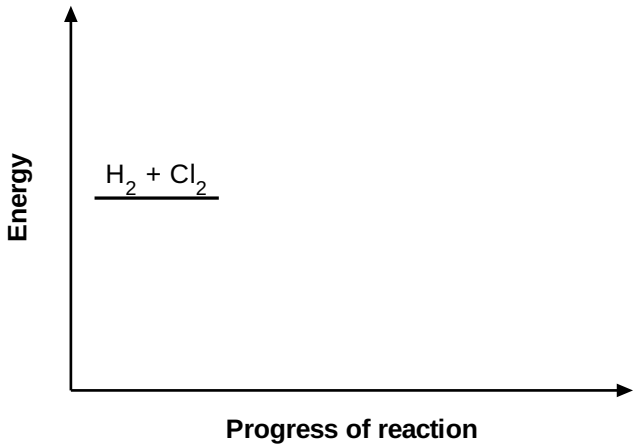
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0 3 . 3 **Figure 3** shows the energy of the reactants. [3 marks]

Complete **Figure 3** to show the reaction profile for this reaction.

Label the activation energy and the overall energy change.

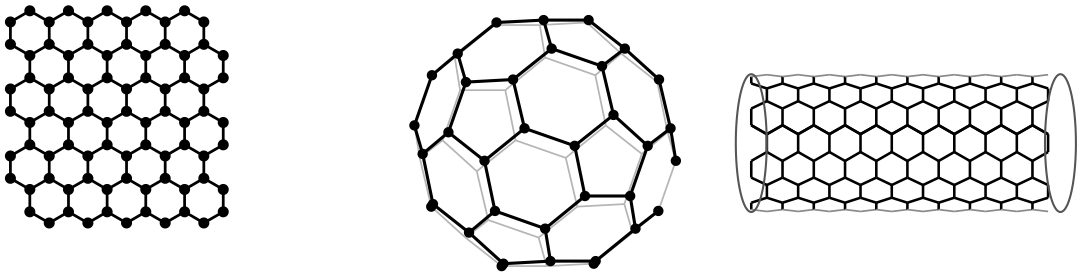
Figure 3



0 4 Carbon forms many different structures.

Figure 4 shows three of them.

Figure 4



Graphene

A fullerene (C_{60})

A carbon nanotube

0 4 . 1 Describe the structure and bonding in graphene. [2 marks]

.....

.....

.....

.....

Question 4 continues on the next page

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0 4 . 2 Graphene conducts electricity. [2 marks]

Explain why.

.....

.....

.....

.....

0 4 . 3 Give **one** way in which the structure of a fullerene is different from the structure of graphene. [1 mark]

.....

.....

0 4 . 4 Give **one** use of carbon nanotubes. [1 mark]

.....

0 4 . 5 A carbon nanotube is 1.5 μm long. Its diameter is 1.0 nm [1 mark]

1 μm = 1000 nm

Calculate the ratio of the length of the nanotube to its diameter.

Ratio = ... : 1

Question 4 continues on the next page

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A company is designing a mobile phone with a screen that folds.

The screen needs a layer that lets light through and conducts electricity.

Table 3 gives information about three materials that could be used for this layer.

Table 3

Material	Percentage of light transmitted	Electrical conductivity	Effect of bending	Cost per screen	Other information
Indium tin oxide	90	high	cracks easily	80p	indium is rare
Graphene	97	high	can be bent many times	£2.00	large sheets are difficult to make
Conducting polymer	85	medium	can be bent many times	30p	slowly breaks down in sunlight

0 4 . 6 Evaluate the use of the three materials for the layer in the folding screen. [6 marks]

Use **Table 3** and your knowledge of the structure of graphene.

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0 5 Carbon and silicon are elements in Group 4 of the periodic table.

0 5 . 1 Silicon has the atomic number 14 [1 mark]

Give the electronic structure of a silicon atom.

Table 4 shows the isotopes of silicon.

Table 4

Isotope	Mass number	Percentage abundance
silicon-28	28	92
silicon-29	29	5
silicon-30	30	3

0 5 . 2 State what is meant by **isotopes** of an element. [2 marks]

0 5 . 3 How many neutrons are there in an atom of silicon-30? [1 mark]

_____ neutrons

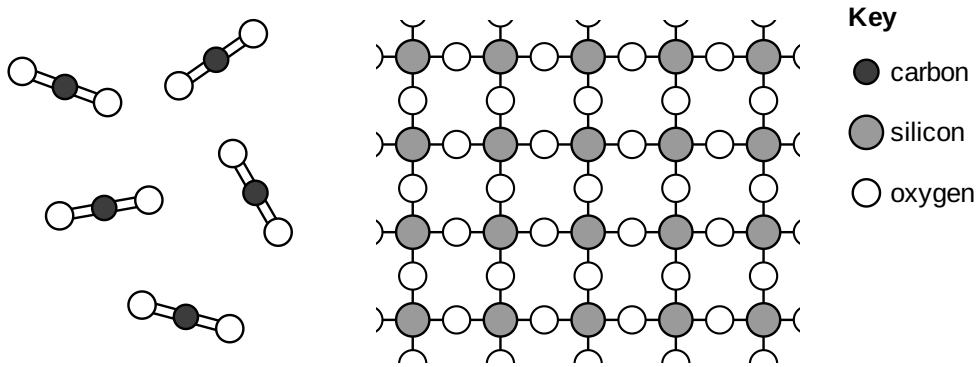
Question 5 continues on the next page

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Carbon dioxide and silicon dioxide have very different properties.

Figure 5 represents their structures.

Figure 5



Carbon dioxide Silicon dioxide

0 5 . 4 What type of bonding holds the atoms together in both substances? [1 mark]

0 5 . 5 Solid carbon dioxide turns into a gas at −78 °C. Silicon dioxide melts at 1710 °C [4 marks]

Explain why silicon dioxide melts at a much higher temperature than the temperature at which carbon dioxide turns into a gas.

Use **Figure 5**.

Turn over for the next question

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0 6 A student investigated the reactivity of three metals, **X**, **Y** and **Z**.

The student added each metal to solutions containing ions of the other metals.

- Metal **X** forms X^{3+} ions.
- Metals **Y** and **Z** form Y^{2+} and Z^{2+} ions.

Table 5 shows the results.

✓ = a reaction happened ✗ = no reaction

Table 5

Metal	Solution containing X^{3+} ions	Solution containing Y^{2+} ions	Solution containing Z^{2+} ions
X	—	✓	✓
Y	✗	—	✓
Z	✗	✗	—

0 6 . 1 Give the order of reactivity of the three metals. [2 marks]

Give a reason for your answer.

Most reactive ☐ ☐ ☐ Least reactive

Reason

.....

.....

0 6 . 2 Complete the balanced ionic equation for the reaction between metal **X** and Y^{2+} ions. [2 marks]

..... X + ... Y^{2+} ⟶ ..... X^{3+} + ... Y

0 6 . 3 Which species is oxidised in this reaction? [2 marks]

Explain your answer in terms of electrons.

.....

.....

.....

0 6 . 4 How many electrons are transferred in the balanced equation in question 06.2? [1 mark]

..... electrons

Question 6 continues on the next page

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0 6 . 5 Metal **X** is extracted by the electrolysis of its molten oxide. [2 marks]

Complete the half equation for the reaction at the negative electrode.

X^{3+} + ... ⟶ .....

0 7 Aluminium nitride (AlN) is a ceramic used in electronics.

Aluminium nitride is made by heating aluminium in nitrogen gas.

Relative atomic masses (A_r): N = 14 Al = 27

0 7 . 1 Calculate the relative formula mass (M_r) of aluminium nitride. [1 mark]

M_r = ...

0 7 . 2 In one experiment, 5.40 g of aluminium reacted with 2.80 g of nitrogen (N_2). [4 marks]

8.20 g of aluminium nitride was produced.

Use these masses to balance the equation for the reaction.

You must show your working.

..... Al + ... N_2 ⟶ ..... AlN

0 7 . 3 Explain why the mass of aluminium nitride produced is equal to the total mass of aluminium and nitrogen that reacted. [1 mark]

.....

.....

0 7 . 4 A 2.70 g sample of impure aluminium was heated in excess nitrogen until the reaction was complete. [4 marks]

The impurities did not react. The mass of the solid increased by 1.26 g

Calculate the percentage by mass of aluminium in the sample.

Percentage of aluminium = ... %

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0 7 . 5 Some of the solid was lost from the container before it was weighed. [2 marks]

Explain how this would affect the calculated percentage of aluminium in the sample.

END OF QUESTIONS

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Additional page, if required.

Write the question numbers in the left-hand margin.

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Additional page, if required.

Write the question numbers in the left-hand margin.

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There are no more questions in this paper. Original practice paper © sciencegcse.co.uk – free to use for non-commercial education. Not an AQA paper.

The Periodic Table of Elements

1	2											3	4	5	6	7	0
		relative atomic mass **atomic symbol** name atomic (proton) number **Key**				1 **H** hydrogen 1											4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[294] **Ts** tennessine 117	[294] **Og** oganesson 118

* The lanthanides (atomic numbers 58–71) and the actinides (atomic numbers 90–103) have been omitted. Relative atomic masses for Cu and Cl have not been rounded to the nearest whole number.