Please write clearly in block capitals.

H

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE

CHEMISTRY

Higher Tier Paper 2

Practice Paper Series – Set 2

Time allowed: 1 hour 45 minutes

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 100.
- 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 questions 02.1 and 05.6 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.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This is an original practice paper written for sciencegcse.co.uk to match the style and demand of AQA GCSE Chemistry (8462) Paper 2 (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 Polymers and composites are useful materials.

0 1 . 1 Glass-reinforced plastic is a composite. It is made of glass fibres in a polymer resin. [2 marks]

Give the job of the glass fibres and the job of the polymer resin in the composite.

Glass fibres

.....

Polymer resin

.....

0 1 . 2 Low density (LD) poly(ethene) and high density (HD) poly(ethene) are both produced from ethene. [1 mark]

Give **one** way in which the production of LD poly(ethene) is different from the production of HD poly(ethene).

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0 1 . 3 A thermosoftening polymer melts when it is heated. A thermosetting polymer does not melt when it is heated. [3 marks]

Explain the difference.

Answer in terms of the structures of the polymers.

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Question 1 continues on the next page

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A company makes plastic toys by pouring hot liquid plastic into moulds at 170 °C

Table 1 gives information about three materials that could be used for the moulds.

Table 1

Material	Type of material	Highest temperature at which the mould can be used in °C	Cost of one mould in £	Number of uses before the mould must be replaced
P	thermosoftening polymer	100	800	500
Q	thermosetting polymer	200	1500	400
R	steel	500	6000	5000

0 1 . 4 The company wants moulds that give the lowest cost for each use. [3 marks]

A manager said:

'We should use material P because the moulds are the cheapest.'

Evaluate the manager's statement.

Use data from **Table 1**.

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Turn over for the next question

0 2 Sodium thiosulfate solution reacts with dilute hydrochloric acid.

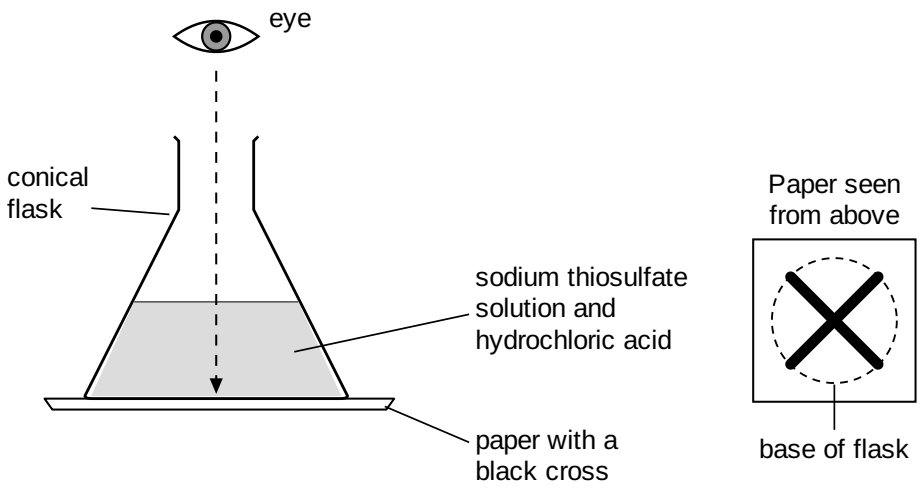
A yellow precipitate of sulfur forms, so the mixture slowly turns cloudy.

A student investigated how the concentration of sodium thiosulfate solution affects the rate of this reaction.

The student timed how long it took for a cross on a piece of paper to disappear from view.

Figure 1 shows the apparatus.

Figure 1



The student had sodium thiosulfate solution with a concentration of 50 g/dm^3, dilute hydrochloric acid, water, measuring cylinders and a stopwatch.

0 2 . 1 Describe a method the student could use to investigate how the concentration of sodium thiosulfate solution affects the time taken for the cross to disappear. [6 marks]

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Question 2 continues on the next page

Table 2 shows the student's results.

The total volume of sodium thiosulfate solution and water was 50 cm^3 in each experiment.

Table 2

Concentration of sodium thiosulfate in g/dm^3	Time for the cross to disappear in s			
	Trial 1	Trial 2	Trial 3	Mean
10	123	127	125	125
20	61	59	60	60
30	42	40	41	41
40	29	31	38	**X**
50	26	24	25	25

0 2 . 2 Calculate mean **X**. [2 marks]

Do **not** include the anomalous result.

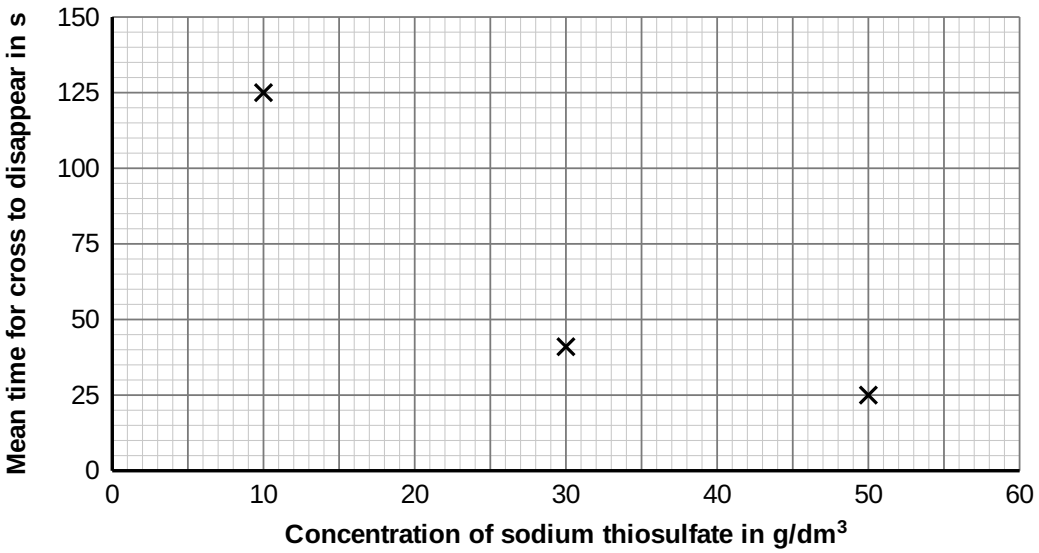
X = ... s

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

Complete **Figure 2**:

- plot the mean times for 20 g/dm^3 and 40 g/dm^3
- draw a line of best fit.

Figure 2



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0 2 . 4 The time taken for the cross to disappear decreased as the concentration of sodium thiosulfate increased. [2 marks]

Explain why, in terms of particles.

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0 2 . 5 A student said: [2 marks]

'The reaction is faster with 50 g/dm^3 sodium thiosulfate solution than with 40 g/dm^3 sodium thiosulfate solution.'

Do the results in **Table 2** support this statement?

Explain your answer.

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0 3 Coal contains sulfur.

Some power stations burn coal.

0 3 . 1 Explain how sulfur dioxide is produced when coal is burned. [1 mark]

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0 3 . 2 Give **one** effect of sulfur dioxide on the environment and **one** effect on human health. [2 marks]

Environment

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Human health

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Question 3 continues on the next page

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0 3 . 3 A power station removes sulfur dioxide from its waste gases. [3 marks]

The waste gases are passed through a mixture of powdered calcium carbonate and water.

$$CaCO_3(s) + SO_2(g) \longrightarrow CaSO_3(s) + CO_2(g)$$

Each hour, the power station removes 4.0 tonnes of sulfur dioxide.

Calculate the volume of carbon dioxide, at room temperature and pressure, produced each hour by this reaction.

- Relative formula mass (M_r): $SO_2 = 64$
- The volume of 1 mole of any gas at room temperature and pressure is 24 dm^3

Give your answer in standard form.

Volume of carbon dioxide = ... dm^3

0 3 . 4 In carbon capture and storage, carbon dioxide is separated from waste gases and stored deep underground. [2 marks]

Explain how this can reduce global warming.

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0 3 . 5 A student said: [2 marks]

'Removing sulfur dioxide in this way does more harm than good, because it releases carbon dioxide.'

- Burning the coal releases 800 tonnes of carbon dioxide each hour.
- Removing the sulfur dioxide releases about 3 tonnes of carbon dioxide each hour.

Evaluate the student's statement.

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0 4 A student tested four solutions, **W**, **X**, **Y** and **Z**.

Each solution contains one compound.

A fresh sample was used for each test.

Table 3 shows the results.

Table 3

Test	Solution W	Solution X	Solution Y	Solution Z
Flame test	green flame	no clear colour	crimson flame	lilac flame
Add sodium hydroxide solution	blue precipitate	brown precipitate	no change	no change
Add dilute hydrochloric acid	no change	no change	bubbles of a gas that turns limewater milky	no change
Add dilute nitric acid, then silver nitrate solution	no change	white precipitate	bubbles, then no precipitate	cream precipitate
Add dilute hydrochloric acid, then barium chloride solution	white precipitate	no change	bubbles, then no precipitate	no change

0 4 . 1 Identify the compound in each solution. [4 marks]

W .....

X .....

Y .....

Z .....

0 4 . 2 Complete the ionic equation for the reaction of solution **Z** with silver nitrate solution. [2 marks]

$Ag^+(aq)$ + ... ⟶ ..... (s)

0 4 . 3 Why is dilute nitric acid added before the silver nitrate solution? [1 mark]

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Question 4 continues on the next page

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0 4 . 4 Explain why dilute hydrochloric acid is **not** used instead of dilute nitric acid in the test with silver nitrate solution. [1 mark]

0 4 . 5 Describe how a flame test is done on solution **W**. [2 marks]

0 4 . 6 A different student added dilute hydrochloric acid to an unknown solution. Bubbles of gas were produced. [2 marks]

The student concluded:

'The solution contains carbonate ions.'

Explain why the student's conclusion may not be valid.

Give the test that would show that the gas is carbon dioxide.

0 5 Ethanol is an alcohol.

Ethanol can be produced by the fermentation of sugar.

0 5 . 1 Draw the displayed formula of ethanol, C_2H_5OH [1 mark]

0 5 . 2 A small piece of sodium is added to some ethanol. [2 marks]

Give **two** observations.

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0 5 . 3 Ethanol is oxidised by an oxidising agent. [1 mark]

Name the organic product.

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0 5 . 4 Give **three** conditions needed to produce ethanol by the fermentation of sugar. [3 marks]

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0 5 . 5 The equation for the fermentation of glucose is: [4 marks]

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

A company dissolved 45.0 kg of glucose in water.

Only 80.0% of the glucose was fermented.

Calculate the mass of ethanol produced.

Relative formula masses (M_r): $C_6H_{12}O_6 = 180$ $C_2H_5OH = 46$

Mass of ethanol = ... kg

Question 5 continues on the next page

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Ethanol can also be produced by reacting ethene with steam.

Table 4 compares the two methods of producing ethanol.

Table 4

	Fermentation of sugar	**Reaction of ethene with steam**
Raw material	sugar from sugar cane (a crop)	ethene from crude oil
Type of process	batch (the reaction is stopped and restarted)	continuous
Rate of reaction	slow (several days)	fast
Energy needed	low	high (high temperature and pressure)
Product	a solution of about 15% ethanol in water	almost pure ethanol
Atom economy	51%	100%

0 5 . 6 Evaluate the two methods of producing ethanol. [6 marks]

Use **Table 4** and your own knowledge.

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0 6 Flame emission spectroscopy can be used to measure the concentration of metal ions in a solution.

0 6 . 1 Describe how flame emission spectroscopy is used to identify the metal ions in a solution. [2 marks]

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Question 6 continues on the next page

A scientist measured the emission reading for solutions with known concentrations of sodium ions.

Table 5 shows the results.

Table 5

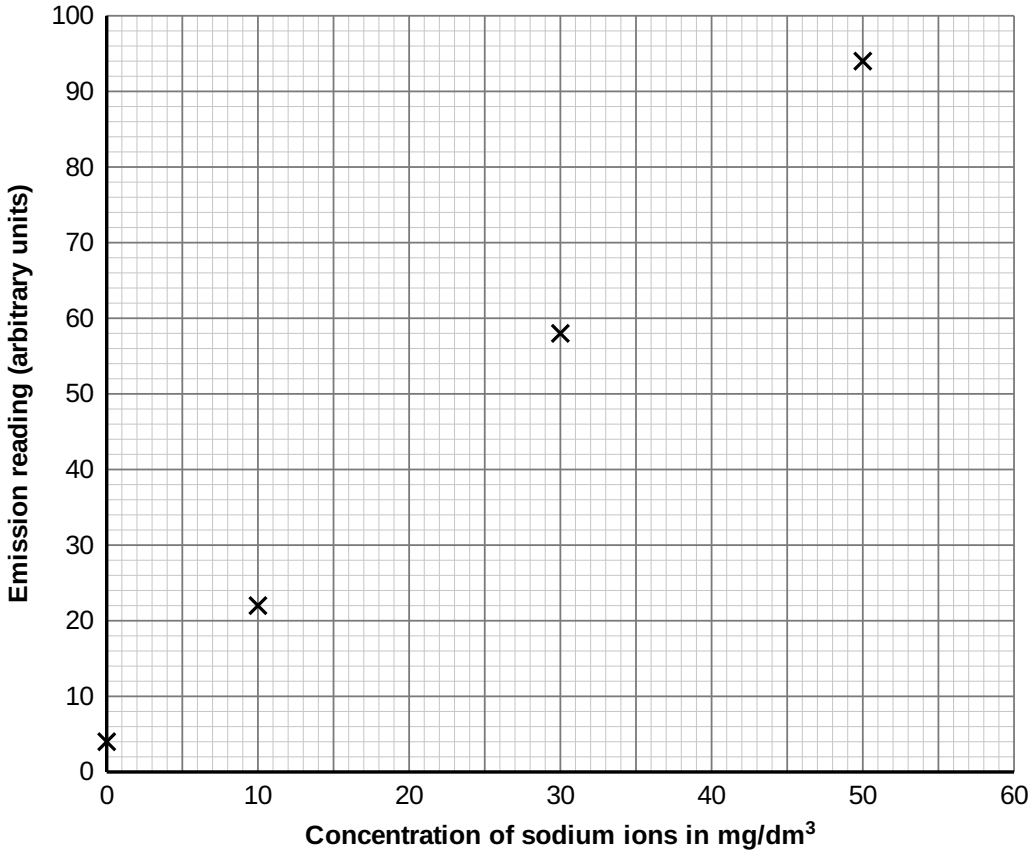
Concentration of sodium ions in mg/dm^3	0	10	20	30	40	50
Emission reading	4	22	40	58	76	94

0 6 . 2 **Figure 3** shows some of the results. [3 marks]

Complete **Figure 3**:

- plot the readings for 20 mg/dm^3 and 40 mg/dm^3
- draw a line of best fit.

Figure 3



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Question 6 continues on the next page

0 6 . 3 Give **two** advantages of flame emission spectroscopy compared with simple flame tests. [2 marks]

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0 6 . 4 The emission reading for the solution with no sodium ions was not zero. [1 mark]

Suggest **one** reason why.

0 6 . 5 A sample is more concentrated than the highest calibration standard. [1 mark]

Suggest how the scientist could prepare the sample so that its concentration can be measured using this calibration.

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Turn over for the next question

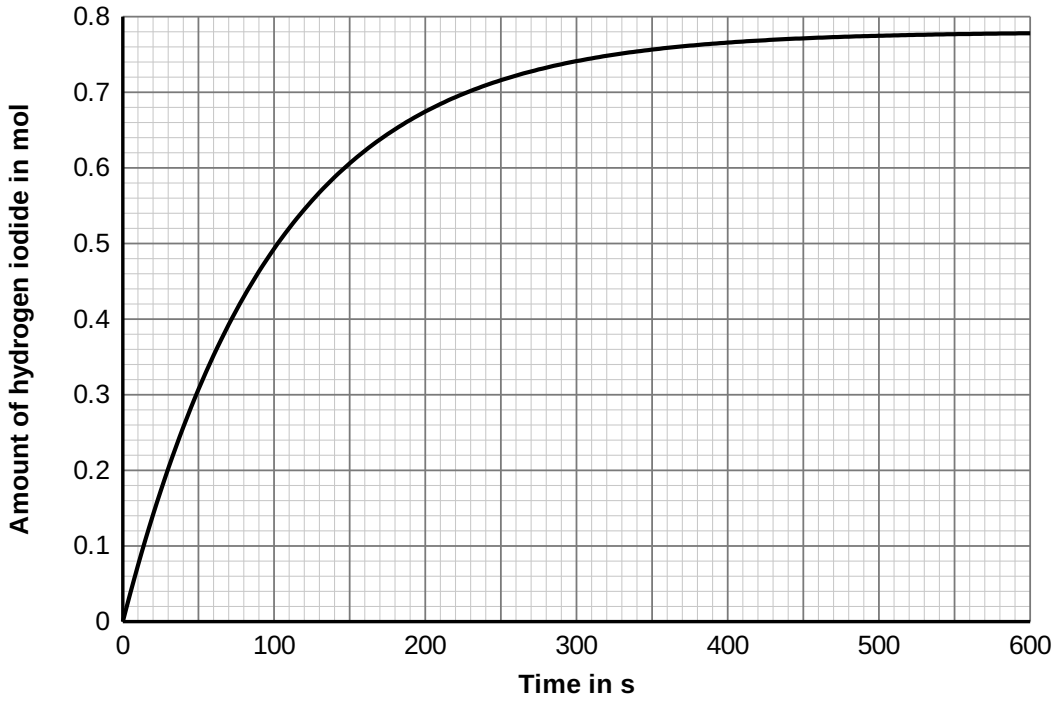
0 7 Hydrogen reacts with iodine to produce hydrogen iodide.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

A scientist put 0.50 mol of hydrogen and 0.50 mol of iodine into a sealed container at 450 °C

Figure 4 shows how the amount of hydrogen iodide changed with time.

Figure 4



0 7 . 1 Determine the rate of reaction at 100 seconds. [3 marks]

Show your working on **Figure 4**.

Give your answer in standard form.

Rate = ... mol/s

0 7 . 2 After 500 seconds the amount of hydrogen iodide does not change, but there is still some hydrogen and iodine in the container. [2 marks]

Explain why.

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0 7 . 3 The forward reaction is exothermic. [2 marks]

The scientist repeated the experiment at a higher temperature.

All the other conditions were the same.

Draw a line on **Figure 4** to show how the amount of hydrogen iodide would change with time at the higher temperature.

0 7 . 4 The pressure in the container is increased. [2 marks]

Explain why the amount of hydrogen iodide at equilibrium does not change.

0 7 . 5 More hydrogen is added to the equilibrium mixture. [2 marks]

The temperature and the volume of the container stay the same.

Explain what happens to the amount of iodine in the mixture.

0 8 Some countries do not have enough fresh water.

These countries produce potable water from sea water.

0 8 . 1 What is meant by **potable water**? [1 mark]

Question 8 continues on the next page

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Sea water can be desalinated by distillation or by reverse osmosis.

Table 6 gives information about the two methods.

Table 6

	Distillation	**Reverse osmosis**
Energy needed to produce 1 m^3 of potable water in kWh	18	4
Percentage of the sea water that becomes potable water	25	45
Concentration of dissolved salts in the potable water in mg/dm^3	20	250
Other information	can use waste heat from a nearby power station	the membranes must be replaced every few years

The concentration of dissolved salts in potable water must be less than 500 mg/dm^3

0 8 . 2 Evaluate the use of distillation and reverse osmosis to produce potable water from sea water. [4 marks]

Use **Table 6**.

0 8 . 3 Calculate the volume of sea water needed to produce 900 m^3 of potable water by reverse osmosis. [2 marks]

Volume of sea water = ... m^3

Question 8 continues on the next page

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0 8 . 4 A student checked the concentration of dissolved salts in some potable water made by reverse osmosis. [2 marks]

- The student evaporated 50 cm^3 of the water to dryness.
- The student then weighed the solid left, using a balance that measures to the nearest 0.01 g

Use **Table 6** to explain why the student's method would not give an accurate result.

Suggest **one** improvement to the method.

0 9 A café can serve hot drinks in single-use paper cups or in reusable ceramic mugs.

0 9 . 1 Life cycle assessments (LCAs) are used to compare the environmental impact of products. [2 marks]

LCAs are not always objective.

Give **two** reasons why.

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Question 9 continues on the next page

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Table 7 shows the energy used in the life cycle of one paper cup and one ceramic mug.

A paper cup is used once and then disposed of. The mug is washed after every use, including its final use.

Table 7

Stage of the life cycle	Energy used in kJ	
	Paper cup	Ceramic mug
Extracting and processing the raw materials	350	7000
Manufacturing the cup or mug	200	8000
Washing after each use	0	180
Disposal	20	300

0 9 . 2 Calculate the minimum number of times a ceramic mug must be used so that it uses less energy than using a new paper cup each time. [3 marks]

Minimum number of uses = ...

0 9 . 3 The owner of the café said: [3 marks]

'Ceramic mugs are always better for the environment than paper cups.'

Evaluate the owner's statement.

Use **Table 7** and your own knowledge.

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END OF QUESTIONS

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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.