Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier Chemistry Paper 2

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 02.1 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 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 This question is about pure substances and formulations.

0 1 . 1 The label on a jar of honey says '100% pure'. [2 marks]

This means that nothing has been added to the honey.

Explain why a chemist would **not** describe honey as pure.

Pure paracetamol melts at 169 °C

A student measured the melting points of two samples of paracetamol, **A** and **B**.

Table 1 shows the results.

Table 1

Sample	**A**	**B**
Melting point in °C	169	158–164

0 1 . 2 Which sample, **A** or **B**, is impure? [2 marks]

Give a reason for your answer.

Sample .....

Reason

0 1 . 3 Paracetamol tablets are formulations. [1 mark]

Give **one** other example of a formulation.

Question 1 continues on the next page

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Table 2 shows the substances in one paracetamol tablet.

Table 2

Substance	Purpose	Mass in one tablet in mg
Paracetamol	the medicine (a painkiller)	500
Starch	helps the tablet break up in the stomach	45
Povidone	binder that holds the powder together	12
Magnesium stearate	stops the tablet sticking to the machine	3

0 1 . 4 Calculate the percentage by mass of paracetamol in the tablet. [2 marks]

Percentage of paracetamol = ... %

0 1 . 5 A student said: [2 marks]

'If the mass of the binder in each tablet was doubled, the tablets would work in the same way, because they would still contain the same substances.'

Explain why the student is wrong.

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Turn over for the next question

0 2 Sodium thiosulfate solution reacts with dilute hydrochloric acid.

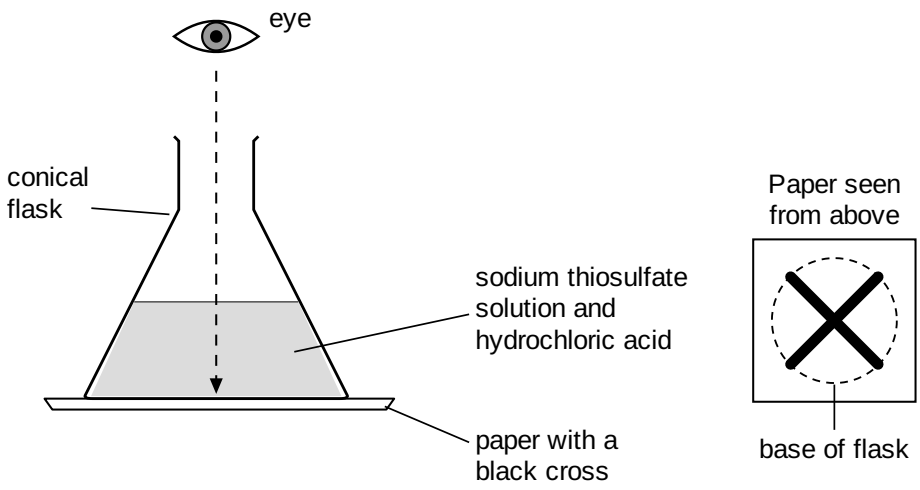
A yellow precipitate of sulfur forms, so the mixture slowly turns cloudy.

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

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Table 3 shows the student's results.

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

Table 3

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.

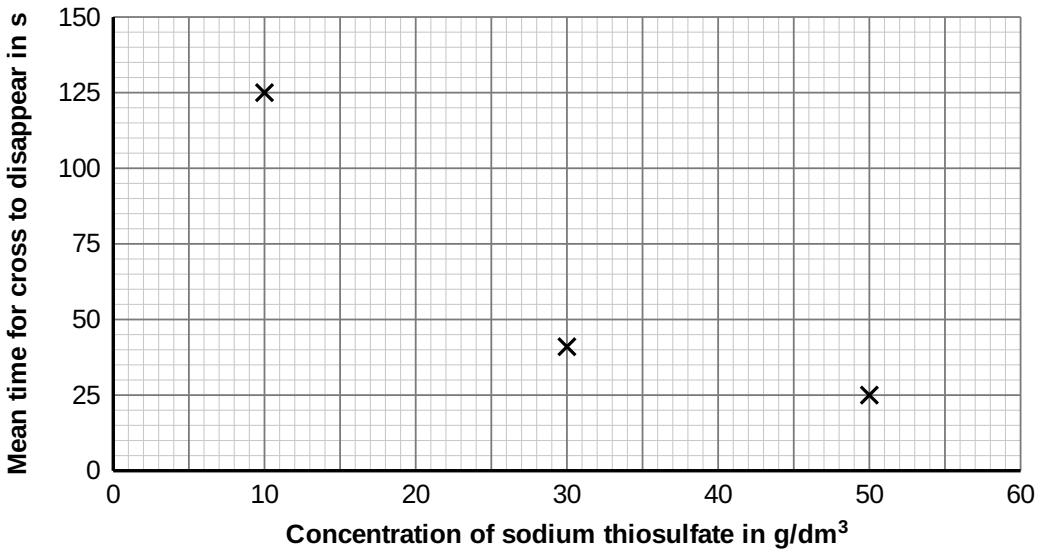
X = ... s

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.

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 3** support this statement?

Explain your answer.

0 3 Natural gas (methane) and coal are fossil fuels.

They are burned in power stations to generate electricity.

0 3 . 1 The carbon in coal was once carbon dioxide in the Earth's atmosphere, millions of years ago. [2 marks]

Explain how this carbon became locked up in coal.

Question 3 continues on the next page

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0 3 . 2 The equation for the complete combustion of methane is: [3 marks]

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

A power station burns 8.0 tonnes of methane.

Calculate the mass of oxygen needed.

Relative formula masses (M_r): $CH_4 = 16$ $O_2 = 32$

Mass of oxygen = ... tonnes

Table 4 gives information about burning methane and coal.

Table 4

Fuel	Energy released when 1 kg of the fuel burns in MJ	Mass of carbon dioxide released when 1 kg of the fuel burns in kg
Methane	55	2.75
Coal	30	2.80

0 3 . 3 Assume the two power stations convert the same percentage of the energy released by the fuel into electrical energy. [3 marks]

An energy company said:

'Generating electricity by burning methane instead of coal halves the mass of carbon dioxide released.'

Evaluate the company's statement.

Use **Table 4**.

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Question 3 continues on the next page

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0 3 . 4 In carbon capture and storage, carbon dioxide is separated from waste gases and stored deep underground. [1 mark]

Explain how this can reduce global warming.

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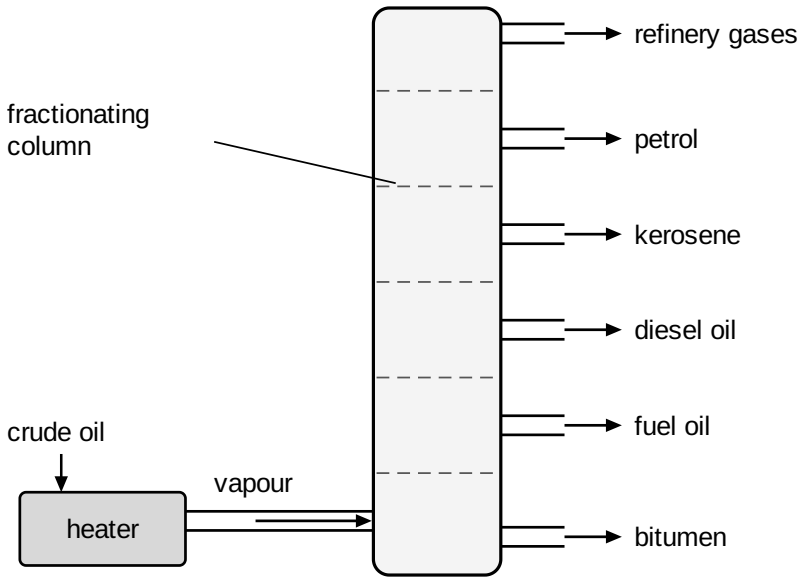
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0 4 Crude oil is a mixture of hydrocarbons.

Crude oil is separated into fractions by fractional distillation.

Figure 3 shows a fractionating column.

Figure 3



0 4 . 1 Describe how crude oil is separated into fractions in the fractionating column. [3 marks]

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Question 4 continues on the next page

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0 4 . 2 Fuel oil has a higher boiling point than petrol. [2 marks]

Explain why.

Answer in terms of the molecules in each fraction.

0 4 . 3 Propane is in the refinery gases fraction. [1 mark]

Draw the displayed formula of propane, C_3H_8

0 4 . 4 Describe how long-chain hydrocarbons are converted into shorter-chain hydrocarbons by catalytic cracking. [3 marks]

0 5 A café can serve hot drinks in single-use paper cups or in reusable ceramic mugs.

0 5 . 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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Table 5 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 5

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 5 . 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 5 . 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 5** and your own knowledge.

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Turn over for the next question

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0 6 Some countries do not have enough fresh water.

These countries produce potable water from sea water.

0 6 . 1 What is meant by **potable water**? [1 mark]

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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 6 . 2 Evaluate the use of distillation and reverse osmosis to produce potable water from sea water. [4 marks]

Use **Table 6**.

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Question 6 continues on the next page

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0 6 . 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

0 6 . 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.

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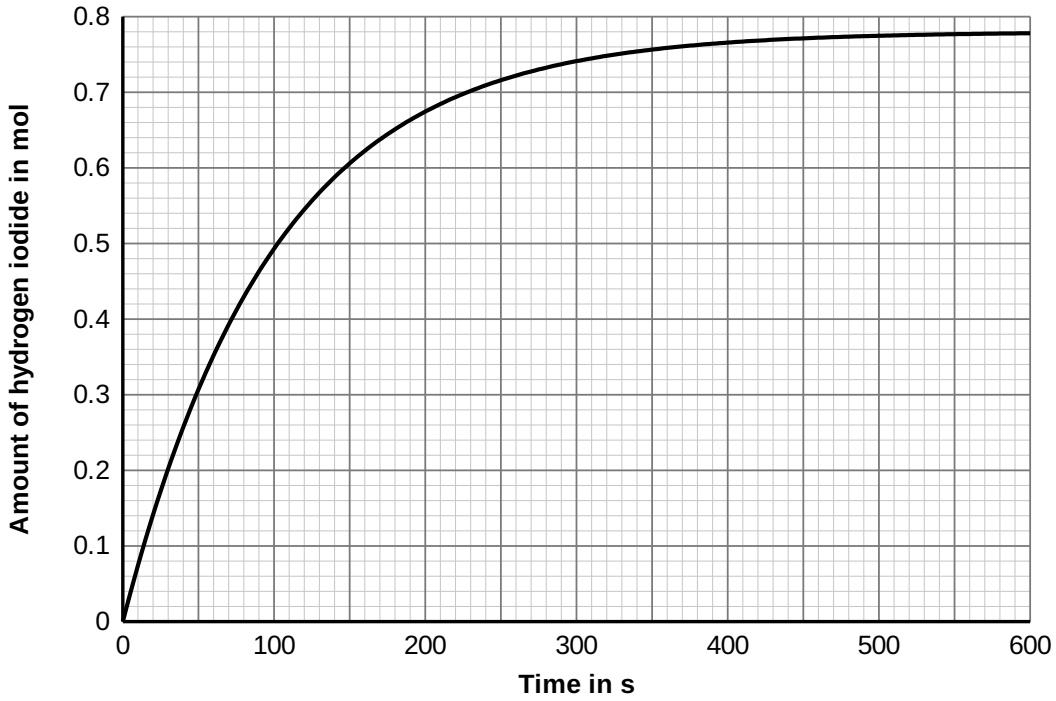
0 7 Hydrogen reacts with iodine to produce hydrogen iodide.

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

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.

END OF QUESTIONS

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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.