AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 2H

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.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- 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.

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

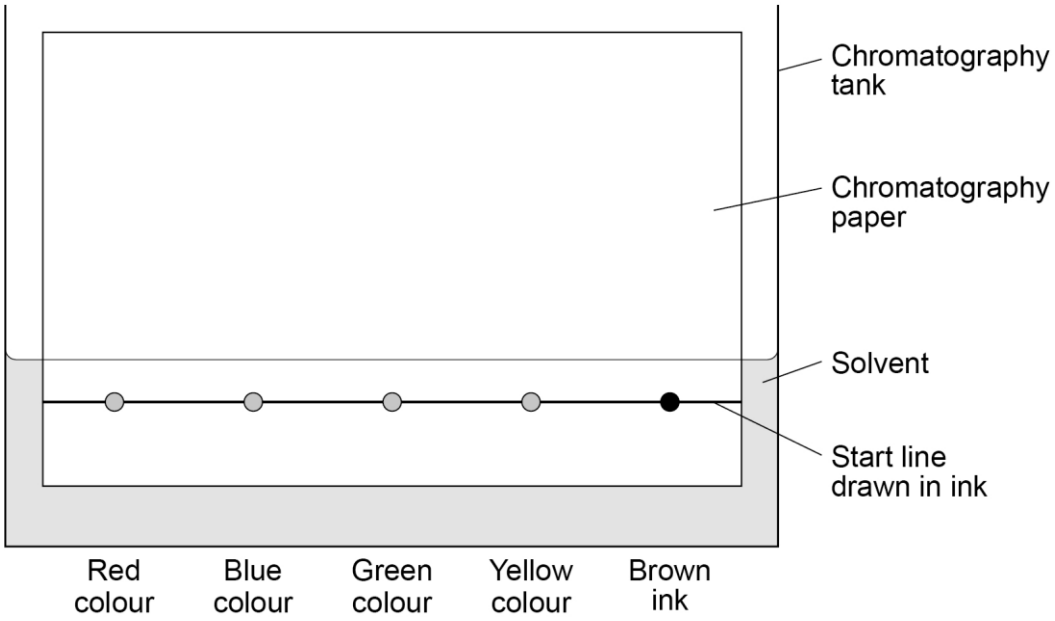
Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 A student investigated the colours in a brown ink using chromatography.

0 1 . 1 **Figure 1** shows the apparatus used.

Figure 1



Give **two** errors made by the student.

Describe the problem each error would cause.

[4 marks]

Error 1 start line drawn in ink

Problem 1 so ink will mix with solvent

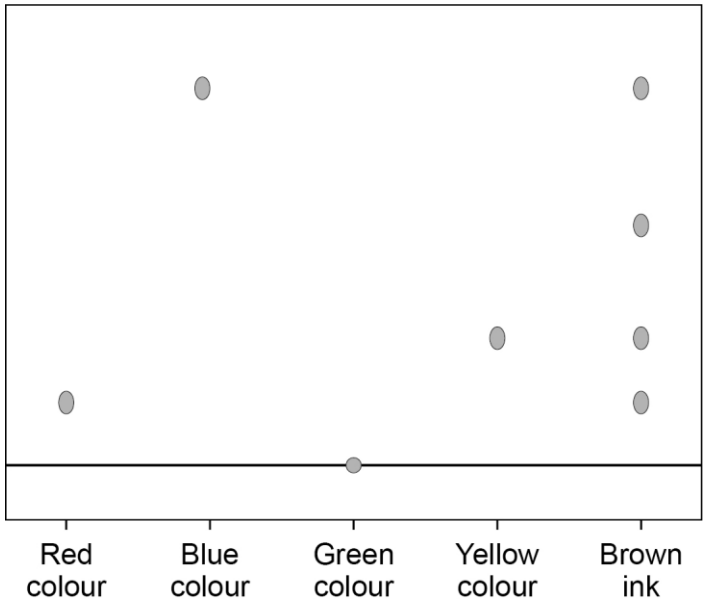
Error 2 the solvent is above the start line

Problem 2 so colours / ink will dissolve

A different student set up the apparatus correctly.

Figure 2 shows the results.

Figure 2



0 1 . 2 Give **two** conclusions the student can make from **Figure 2** about the four colours in the brown ink.

[2 marks]

1 the brown ink contains the blue, yellow and red colours

2 the brown ink contains an unknown colour

Question 1 continues on the next page

Do not write outside the box

0 1 . 3 Why was the green colour still on the start line at the end of the experiment?

[1 mark]

Tick (✓) **one** box.

- The experiment was left for too long. ☐
- The green colour was insoluble in the solvent. ☑
- The green spot contained too many colours. ☐
- The green spot was too small. ☐

0 1 . 4 A student calculated the R_f value of a colour to be 0.24

The colour moved 1.8 cm from the start line.

Calculate the distance the solvent moved.

Use the equation:

$$R_f = \frac{\text{distance moved by colour}}{\text{distance moved by solvent}}$$

[3 marks]

$0.24 = \frac{1.8}{\text{distance moved by solvent}}$

$\text{distance moved by solvent} = \frac{1.8}{0.24}$

$= 7.5$ (cm)

Distance moved by solvent = _____ cm

10

Do not write outside the box

0 2 . 1 Water that is safe to drink is called potable water.

Compare how easily potable water can be obtained from:

- waste water (sewage)
- ground water (fresh water).

[6 marks]

GROUND WATER

easier to obtain

fewer processes

takes less time

filtered through filter beds to remove insoluble particles

sterilised using chlorine, ozone or uv light to kill bacteria

WASTE WATER

more difficult to obtain

more processes

takes more time

screening and grit removal to remove large particles

sedimentation to produce sewage sludge and effluent

aerobic biological treatment of effluent

to reduce solid waste and then sterilised using chlorine, ozone or uv light

to kill bacteria

sludge is anaerobically digested by specific bacteria to remove organic matter

Question 2 continues on the next page

Do not write outside the box

A scientist produced potable water from 150 cm^3 of salty water.

0 2 . 2 Which process can be used to produce potable water from salty water?

[1 mark]

Tick (✓) **one** box.

- Distillation ✓
- Electrolysis
- Filtration
- Sterilisation

0 2 . 3 The salty water contains sodium chloride.

The scientist collected 2.40 g of sodium chloride from 150 cm^3 of salty water.

Calculate the concentration of sodium chloride in grams per dm^3

[3 marks]

conversion= $\frac{150}{1000}$

=0.15 (dm3)

concentration = $\frac{2.40}{0.15}$

= 16 (g/dm3)

Concentration of sodium chloride = _____ g/dm^3

10

Do not write outside the box

0 3 This question is about the reaction between sodium thiosulfate solution and hydrochloric acid.

The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

0 3 . 1 The mass of the conical flask and contents was greater at the start of the reaction than at the end.

Explain why.

[2 marks]

sulfur dioxide produced which escapes from the conical flask

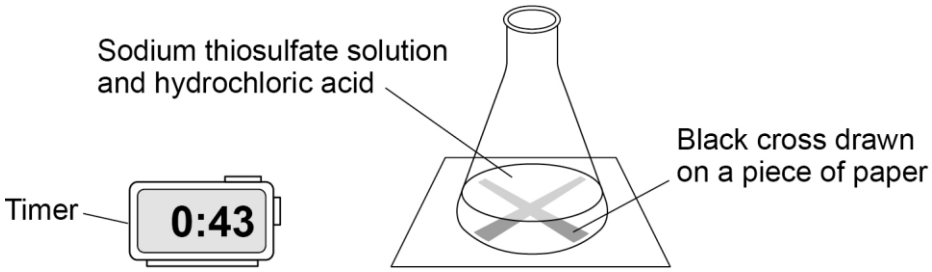
Question 3 continues on the next page

A teacher demonstrated the reaction between sodium thiosulfate solution and hydrochloric acid.

Figure 3 shows the experiment.

The experiment was done in a fume cupboard.

Figure 3



This is the method the teacher used.

1. Pour 50 cm^3 of sodium thiosulfate solution into a conical flask.

2. Put the conical flask on a black cross drawn on a piece of paper.

3. Pour 10 cm^3 of hydrochloric acid into the conical flask and start a timer.

4. Stop the timer when the cross can no longer be seen.

5. Repeat the experiment at different temperatures.

0 3 . 2 What type of variable is time in this reaction?

[1 mark]

Tick (✓) **one** box.

Control ☐

Dependent ☑

Independent ☐

Do not write outside the box

0 3 . 3 **Table 1** shows the results.

Table 1

Temperature in °C	Time in seconds
19	82
32	48
45	43
52	15
63	7
73	3

Complete **Figure 4**.

You should:

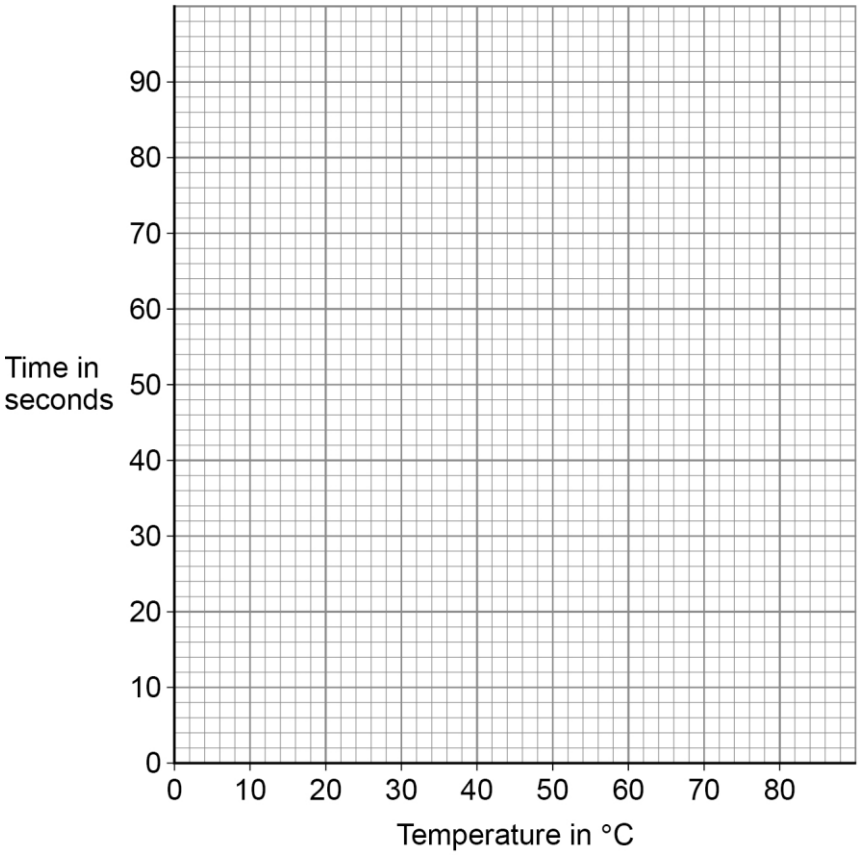
- plot the data from **Table 1** on **Figure 4**
- draw a line of best fit.

[3 marks]

Figure 4

all points correctly plotted

line of best fit



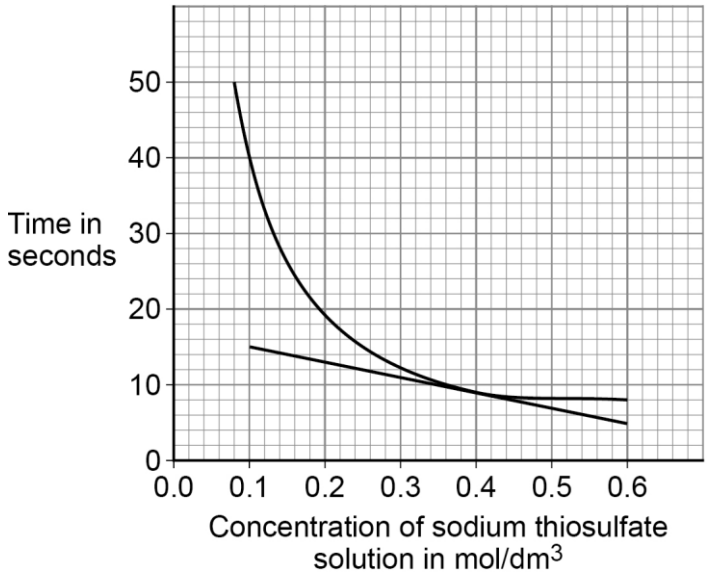
Turn over ►

Do not write outside the box

0 3 . 4 A student investigated the effect of concentration of sodium thiosulfate on the time taken for the reaction at room temperature.

Figure 5 shows the results with a tangent drawn at 0.4 mol/dm^3

Figure 5



Calculate the gradient (slope) of the tangent at 0.4 mol/dm^3

Give the unit.

[4 marks]

correct values for x step and y step from tangent

(rate =) value for y step / value for x step

correct calculation of rate

s dm3/mol

Gradient = _____

Unit = _____

Do not write outside the box

0 3 . 5 The student determined the **rate** of the reaction at regular time intervals during an experiment.

Explain why the **rate** decreased during the reaction.

You should give your answer in terms of particles.

[2 marks]

as reaction proceeds fewer sodium thiosulfate particles per unit volume

so frequency of particle collisions decreases

12

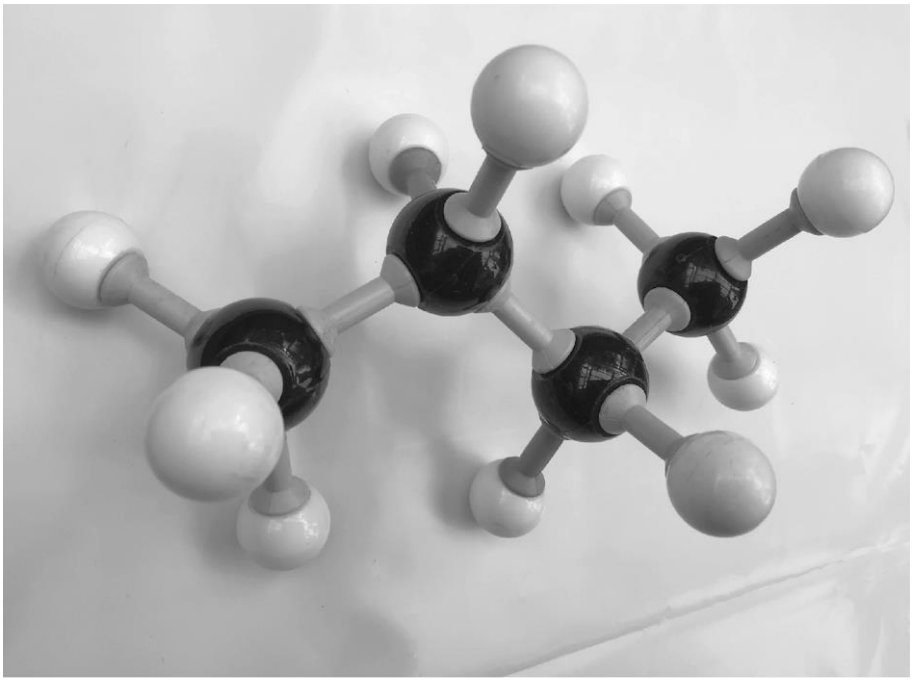
Turn over for the next question

Do not write outside the box

0 4 This question is about hydrocarbons and the uses of hydrocarbons.

0 4 . 1 **Figure 6** shows a model of an alkane.

Figure 6



What is the name of the alkane in **Figure 6**?

[1 mark]

butane

0 4 . 2 What is a hydrocarbon?

[1 mark]

molecule made up of carbon and hydrogen atoms only

Do not write outside the box

Large hydrocarbon molecules are cracked.

0 4 . 3 When $C_{11}H_{24}$ is cracked, three products are formed.

Complete the equation for the reaction.

[2 marks]

$$C_{11}H_{24} \rightarrow C_5H_{10} + 2\ C_2H_4 + C_2H_6$$

0 4 . 4 Explain why **one** of the products of cracking is in high demand.

[2 marks]

C2H6 is useful as a fuel because more flammable than larger molecules

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 Window frames can be manufactured from wood or from plastic.

Table 2 shows data from a life cycle assessment (LCA) for a wooden window frame and a plastic window frame.

Both window frames are the same size.

Table 2

	Wood	**Plastic**
Sources of hydrocarbons used for production in kg	5.37	18.23
Greenhouse gases released during production, use and disposal in kg equivalent of CO_2	457	487
Oxides of nitrogen and sulfur dioxide produced in arbitrary units	29.6	37.7
Waste materials in kg	16.5	28.8
Total energy consumption in production, use and disposal in MJ	9150	9713
Lifetime cost to customer to buy and maintain in £	147	102

Do not write outside the box

Evaluate the sustainability of wooden and plastic window frames.

You should include environmental and economic factors.

[6 marks]

production of plastic uses more hydrocarbons which are from non-renewable crude oil

• production of plastic produces more greenhouse gases in the atmosphere which contributes to global warming
• production of plastic produces more sulfur dioxide which causes acid rain
• production of plastic produces more oxides of nitrogen which cause acid rain and respiratory problems
• disposal of plastic produces more waste which increases landfill
• burning plastic produces fumes which are toxic so cause respiratory problems

• lifetime cost of plastic frames is less
• plastic frames have lower costs for maintaining

• the total energy consumption for plastic frames is greater than for wooden frames

• judgement

12

Turn over for the next question

Do not write outside the box

0 5 This question is about the Earth's atmosphere and the Earth's resources.

0 5 . 1 After the formation of the Earth's early atmosphere, the amounts of nitrogen and oxygen in the atmosphere changed.

Explain the main changes in the amounts of nitrogen and oxygen in the Earth's atmosphere.

[4 marks]

Nitrogen increased because of emission from volcanoes

Oxygen increased because of photosynthesis

0 5 . 2 Describe how coal was formed from the carbon dioxide present in the Earth's early atmosphere.

[4 marks]

carbon dioxide is used during photosynthesis in trees which die and are compressed over millions of years

0 5 . 3 The combustion of 1.0 kg of coal produces more carbon dioxide than the combustion of 1.0 kg of natural gas.

Suggest why.

[1 mark]

coal has a higher proportion / percentage of carbon

Do not write outside the box

Metals are extracted from metal ores found in the Earth.

0 5 . 4 Describe how bioleaching is used to extract copper from low grade ores.

[3 marks]

uses bacteria to produce solutions containing copper compounds

from which copper is obtained by displacement / electrolysis

0 5 . 5 Phytomining uses plants to extract nickel from low grade ores.

The plants contain 0.792% nickel by mass.

The plants are burned to produce ash.

The ash from these plants contains 4.80% nickel by mass.

Calculate the mass of ash produced from burning 1000 kg of plants.

Give your answer in grams in standard form.

[4 marks]

1000 (kg of plants) gives 7.92 (kg of nickel)

(mass = $\frac{7.92}{4.8} \times 100$

= 165 (kg)

conversion 165 kg = 165 000 (g)

= 1.65×10^{5} (g)

Mass of ash (in standard form) = _____ g

16

Turn over ►

Do not write outside the box

0 6 This question is about catalysts and equilibrium.

0 6 . 1 What type of substance is a catalyst in biological systems?

[1 mark]

Tick (✓) **one** box.

- Algae ☐
- Alkene ☐
- Enzyme ☑
- Formulation ☐

0 6 . 2 Explain how a catalyst increases the rate of a reaction.

[2 marks]

provides a different reaction pathway which has a lower activation energy

Do not write outside the box

The reversible reaction for the production of ammonia is:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

0 6 . 3 What can scientists predict using Le Chatelier's Principle?

[1 mark]

the effects of changing conditions on the position of an equilibrium in a closed system

0 6 . 4 Describe how a reversible chemical reaction is able to reach equilibrium.

[2 marks]

when the forward and reverse reactions have the same rate in apparatus which prevents the escape of reactants and products

0 6 . 5 Explain the effect of increasing the pressure on the yield of ammonia.

[2 marks]

yield increases because there are more moles of gas on the left hand side

0 6 . 6 The forward reaction to produce ammonia is exothermic.

Explain the effect of increasing the temperature on the yield of ammonia.

[2 marks]

yield decreases because the system shifts in the endothermic direction

10

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....
	.....

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED