SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier Paper 4: Chemistry 2H

Specimen 2018 Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a calculator
- the periodic table (enclosed)

Instructions
- 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.

Information
- There are 70 marks available on this paper.
- 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.
- When answering questions 02.4, 03.1 and 05.2 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

Advice
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

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

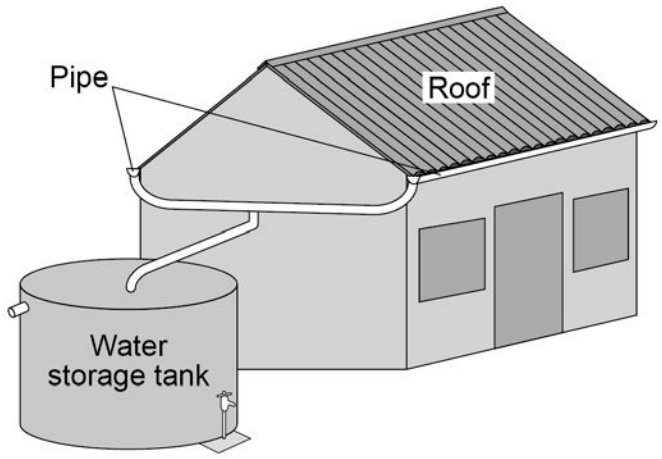
Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Forename(s) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Candidate signature _____

0 1 Rainwater is collected from the roofs of houses as shown in **Figure 1**.

Figure 1



0 1 . 1 The water in the storage tank is **not** potable.

What does potable mean?

[1 mark]

Tick **one** box.

- Contains dissolved substances ☐
- Pure ☐
- Safe to drink ☐
- Tastes nice ☐

0 1 . 2 Why should the water in the tank be filtered to make it potable?

[1 mark]

Tick **one** box.

To kill microbes ☐

To remove dissolved gases ☐

To remove dissolved solids ☐

To remove undissolved solids ☐

0 1 . 3 A gas which bleaches litmus paper can be added to the water to make it potable.

Name this gas and explain why it is added.

[2 marks]

Question 1 continues on the next page

The storage tank is made from concrete reinforced with steel wire, as shown in **Figure 2**.

Figure 2

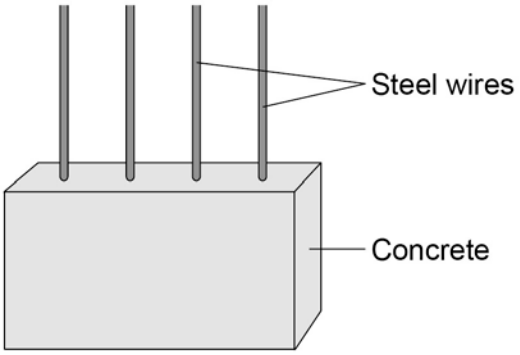
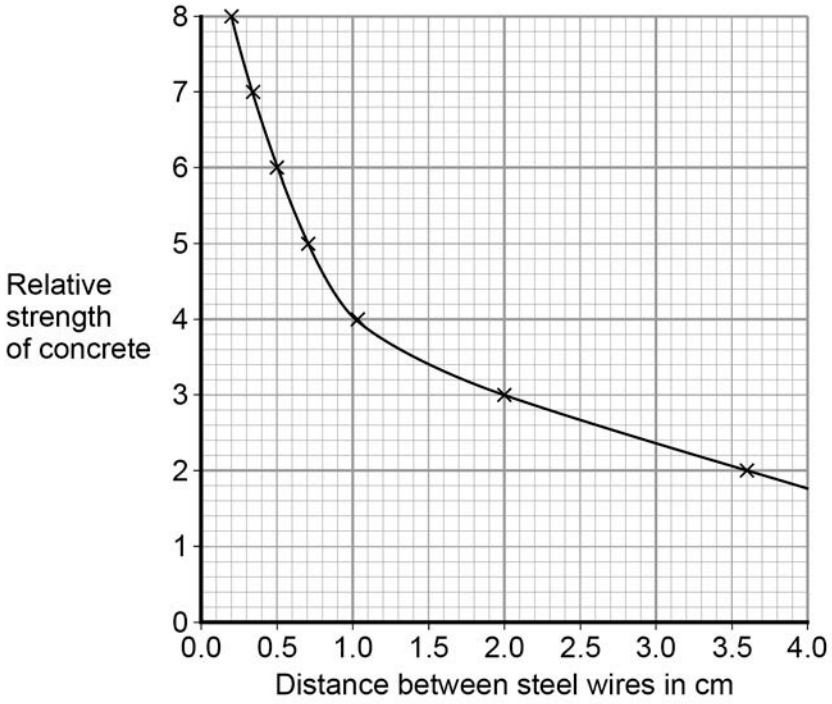


Figure 3 shows how the distance between the steel wires affects the relative strength of the concrete.

Figure 3



0 1 . 4 Use values from **Figure 3** to describe the relationship shown by the graph.

[2 marks]

Turn over for the next question

0 2 . 1 The hydrocarbon $C_{16}H_{34}$ can be cracked.

Balance the equation for cracking $C_{16}H_{34}$

[1 mark]

$C_{16}H_{34}$ → _____ C_2H_4 + C_8H_{18}

0 2 . 2 Describe the differences between cracking and distillation.

[2 marks]

0 2 . 3 What type of reaction is cracking?

[1 mark]

Tick **one** box.

- Combustion ☐
- Decomposition ☐
- Neutralisation ☐
- Precipitation ☐

0 2 . 4 Ethene is used to make poly(ethene).

Poly(ethene) is used to make plastic bags.

Table 1 shows data from a Life Cycle Assessment (LCA) for a plastic bag and a paper bag.

Table 1

	Plastic bag	**Paper bag**
Raw materials	Crude oil or natural gas	Wood
Energy used in MJ	1.5	1.7
Mass of solid waste in g	14	50
Mass of CO_2 produced in kg	0.23	0.53
Volume of fresh water used in dm^3	255	4 520

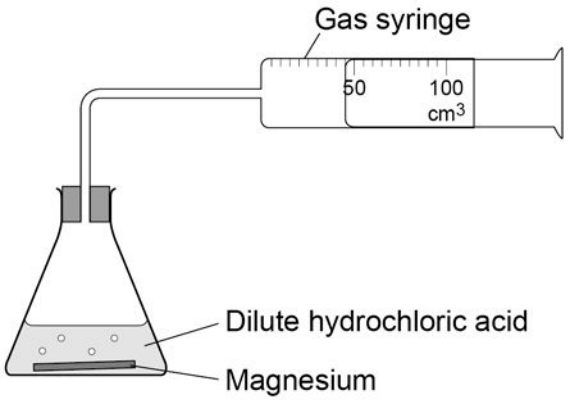
A company stated: 'A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags'.

Evaluate this statement. Use your knowledge and the information from **Table 1**.

[6 marks]

0 3 A student investigated the rate of the reaction between magnesium and dilute hydrochloric acid.
The student used the apparatus shown in **Figure 4** to collect the gas produced.

Figure 4



0 3 . 1 Outline a plan to investigate how the rate of this reaction changed when the concentration of the hydrochloric acid was changed.

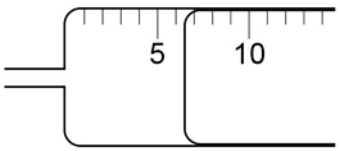
- Describe how you would do the investigation and the measurements you would make.
- Describe how you would make it a fair test.

You do **not** need to write about safety precautions.

[6 marks]

0 3 . 2 **Figure 5** shows the gas syringe during one of the experiments.

Figure 5



What is the volume of gas collected?

[1 mark]

Tick **one** box.

5.3 cm^3 ☐

6.0 cm^3 ☐

6.5 cm^3 ☐

7.0 cm^3 ☐

Question 3 continues on the next page

0 3 . 3 **Figure 6** shows the student's results for one concentration of hydrochloric acid.

Figure 6

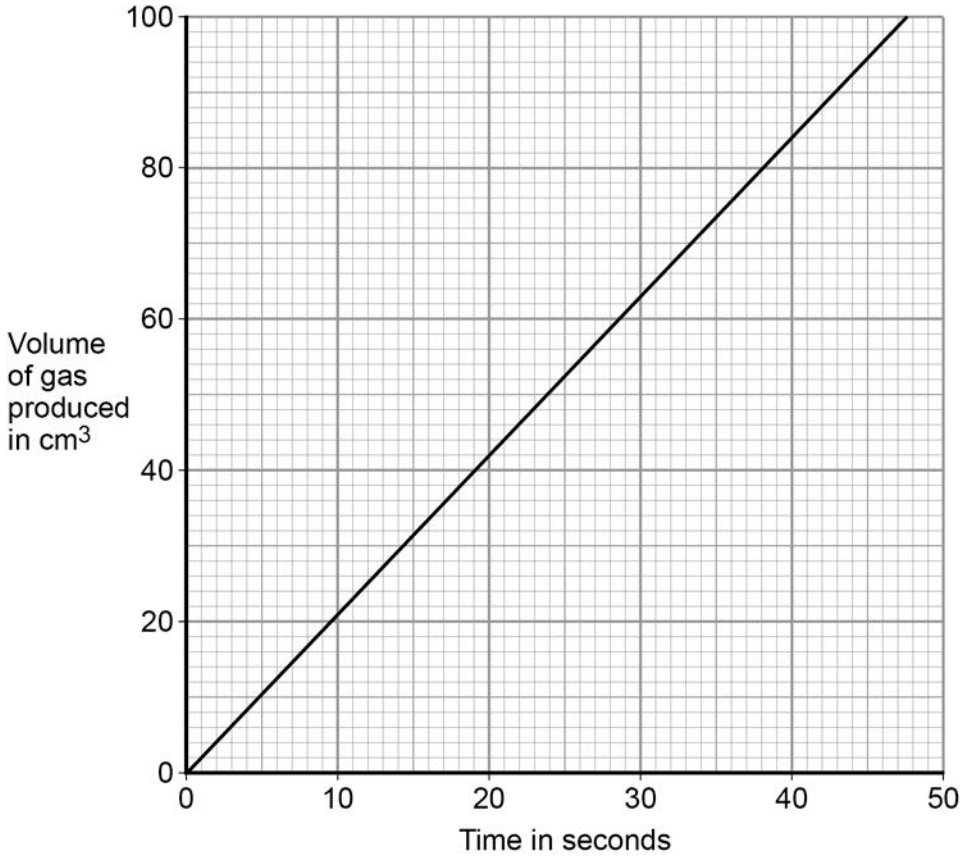


Table 2 shows the student's results when the concentration was two times greater than the results on **Figure 6**.

Table 2

Time in seconds	Volume of gas produced in cm^3
0	0
10	35
15	52
20	80
30	87

Plot the results in **Table 2** on the grid in **Figure 6**.
Draw a line of best fit.

[3 marks]

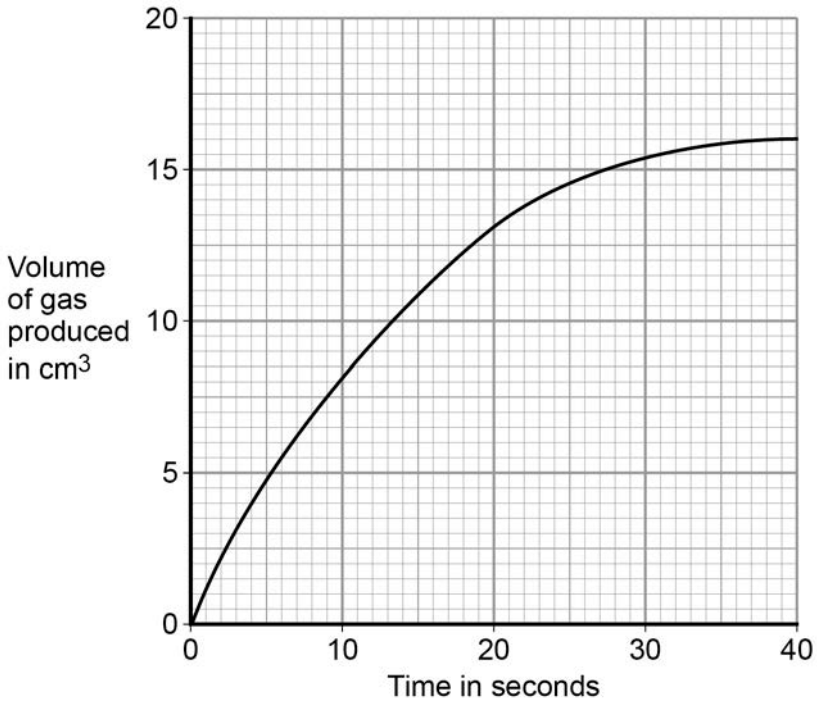
0 3 . 4 Give **one** conclusion about how the rate of reaction changed when the concentration of hydrochloric acid was changed.

[1 mark]

Question 3 continues on the next page

0 3 . 5 **Figure 7** shows volume of gas produced against time for the reaction between magnesium and ethanoic acid.

Figure 7



Draw a tangent to the curve at 20 seconds.

Determine the rate of the reaction at 20 seconds by calculating the gradient of the tangent.

Give the unit.

[4 marks]

Rate of reaction = _____

Unit = _____

0 3 . 6 Explain, in terms of particles, why the rate decreases during the reaction between magnesium and ethanoic acid.

[2 marks]

Turn over for the next question

0 4 Aqamed is a medicine for children.

0 4 . 1 The medicine is a formulation.

What is meant by a formulation?

[1 mark]

0 4 . 2 Children often do not like taking medicine.

Suggest a substance that could be added to Aqamed to increase the desire for children to take it.

Give a reason for your suggestion.

[2 marks]

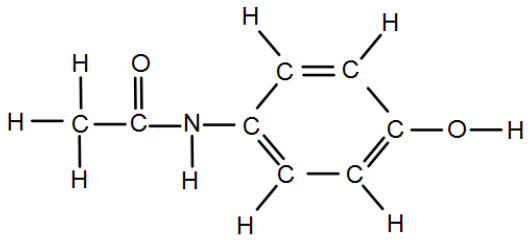
Substance

Reason

0 4 . 3 The main ingredient in Aqamed is a painkiller called paracetamol.

Figure 8 represents a molecule of paracetamol.

Figure 8



Give the molecular formula of paracetamol.

Calculate its relative formula mass (M_r).

Relative atomic masses (A_r): H = 1; C = 12; N = 14; O = 16

[2 marks]

Molecular formula _____

Relative formula mass _____

_____

M_r = _____

Question 4 continues on the next page

0 4 . 4 Aspirin is a medicine for use by adults.

An aspirin tablet contains 300 mg of acetylsalicylic acid.

Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.

Give your answer in standard form to three significant figures.

Relative formula mass (M_r) of aspirin = 180

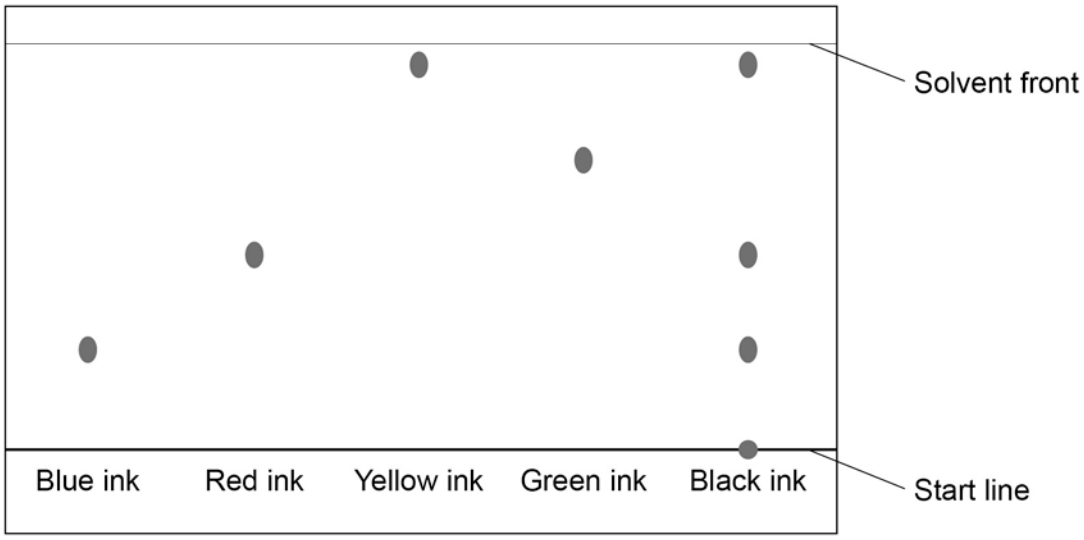
[4 marks]

Number of moles = _____

Turn over for the next question

0 5 **Figure 9** shows a paper chromatogram of five different inks.

Figure 9



0 5 . 1 Explain how paper chromatography separates substances.

[3 marks]

0 5 . 2 Analyse the chromatogram. Describe and explain the result for black ink.

[4 marks]

0 5 . 3 Use **Figure 9** to calculate the R_f value of the blue ink.

[3 marks]

R_f value = _____

Turn over for the next question

There are no questions printed on this page

0 6 There is less carbon dioxide in the Earth's atmosphere now than there was in the Earth's early atmosphere.

0 6 . 1 The amount of carbon dioxide in the Earth's early atmosphere decreased because it was used by plants and algae for photosynthesis, dissolved in the oceans and formed fossil fuels.

Give **one** other way that the amount of carbon dioxide in the Earth's early atmosphere decreased.

[1 mark]

0 6 . 2 Carbon dioxide is a greenhouse gas.

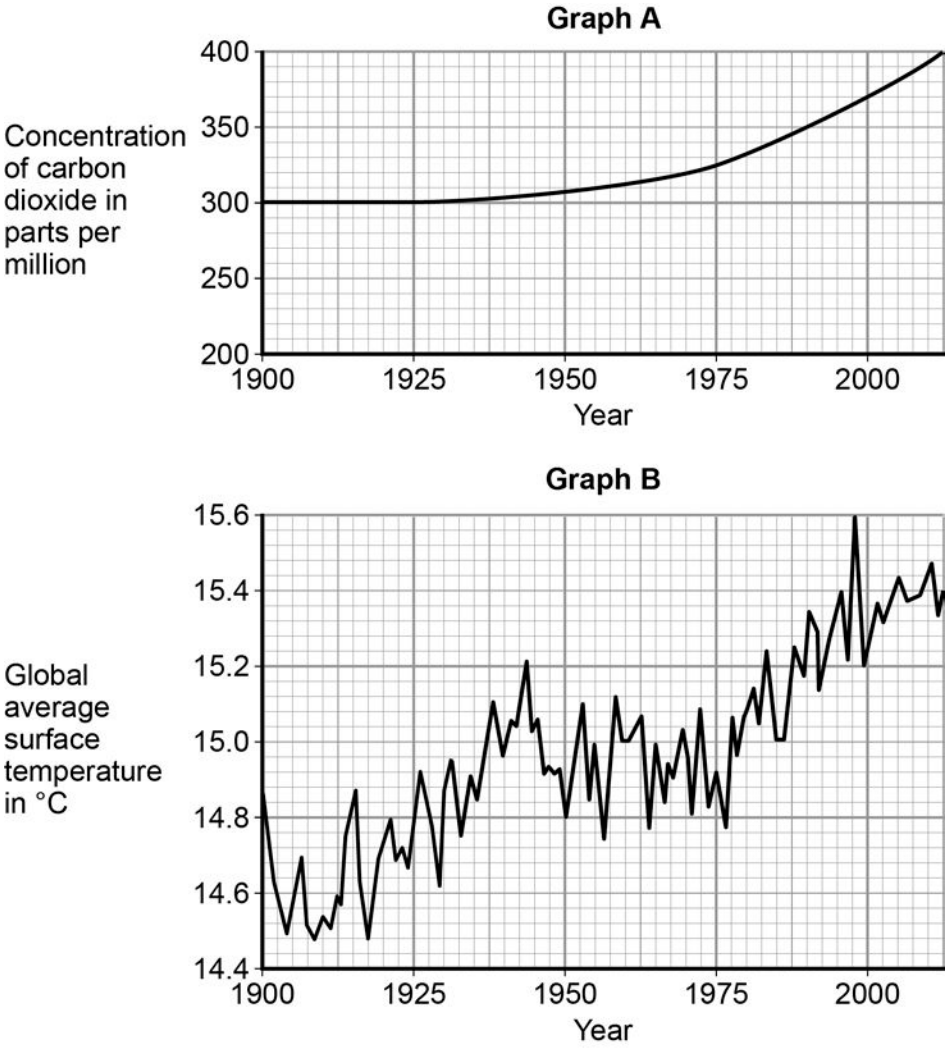
Describe the greenhouse effect.

[4 marks]

Question 6 continues on the next page

The graphs in **Figure 10** show the concentration of carbon dioxide in the atmosphere and global average surface temperature since 1900.

Figure 10



0 6 . 3 Calculate the percentage increase in the concentration of carbon dioxide from 1975 to 2000.

[1 mark]

_____ %

0 6 . 4 What was the global average surface temperature in 1980?

[1 mark]

Global average surface temperature = _____ °C

0 6 . 5 A student stated: 'The graphs show that increasing the concentration of carbon dioxide in the atmosphere causes global temperature increases.'

Discuss why this statement is only partially true.

[4 marks]

Turn over for the next question

0 7 Sulfur dioxide (SO_2) is used to manufacture sulfuric acid.

0 7 . 1 Explain why sulfur dioxide has a low boiling point.

[3 marks]

The equation shows one stage in the manufacture of sulfuric acid from sulfur dioxide.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The reaction is exothermic in the forward direction.

0 7 . 2 Use Le Chatelier's Principle to predict the effect of increasing the temperature on the amount of sulfur trioxide (SO_3) produced at equilibrium.

Give a reason for your answer.

[2 marks]

0 7 . 3 Use Le Chatelier's Principle to predict the effect of increasing the pressure on the amount of sulfur trioxide (SO_3) produced at equilibrium.

Give a reason for your answer.

[2 marks]

END OF QUESTIONS