SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier Paper 4: Chemistry 2F

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 06.4 and 07.1 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 This question is about gases in the Earth's atmosphere.

0 1 . 1 The amount of carbon dioxide in the Earth's atmosphere decreased during the first billion years of the Earth's existence.

Complete the sentences. Use words from the box.

[2 marks]

carbonates	**dissolved**	**evaporated**	**melted**	**nitrates**	**sulfates**

The amount of carbon dioxide in the Earth's atmosphere decreased because

the carbon dioxide _____ in the oceans.

Sediments were formed when _____ were produced.

Algae and plants use carbon dioxide and water to produce oxygen.

0 1 . 2 What is the name of this process?

[1 mark]

Tick **one** box.

- Carbon capture ☐
- Combustion ☐
- Photosynthesis ☐
- Polymerisation ☐

0 1 . 3 Complete the word equation for this process.

[1 mark]

carbon dioxide + _____ → glucose + _____

0 1 . 4 Draw **one** line from each gas to the approximate percentage of the gas in the Earth's atmosphere today.

[3 marks]

Gas	Approximate percentage of gas in the Earth's atmosphere today
Carbon dioxide	5
Nitrogen	20
Oxygen	80

<1
10
50
>90

0 1 . 5 Carbon dioxide is a greenhouse gas.

Why does increasing the amount of carbon dioxide change the global climate?

[1 mark]

Question 1 continues on the next page

0 1 . 6 How can countries reduce carbon dioxide emissions?

[1 mark]

Tick **one** box.

- only burn methane ☐
- use renewable energy supplies ☐
- use waste plastic bags as fuel ☐

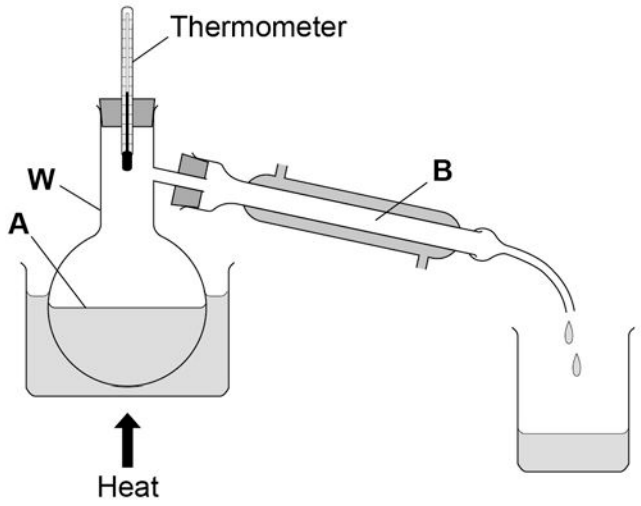
0 1 . 7 Give **one** reason why it is difficult for countries to reduce emissions of carbon dioxide.

[1 mark]

Turn over for the next question

0 2 The apparatus in **Figure 1** is used to separate a mixture of liquids in a fuel.

Figure 1



0 2 . 1 What is apparatus **W** on **Figure 1**?

[1 mark]

Tick **one** box.

- Beaker ☐
- Boiling Tube ☐
- Flask ☐
- Jug ☐

0 2 . 2 What is the name of this method of separation?

[1 mark]

Tick **one** box.

Crystallisation ☐

Electrolysis ☐

Filtration ☐

Distillation ☐

0 2 . 3 Name the changes of state taking place at **A** and **B** in **Figure 1**.

Use words from the box.

[2 marks]

boiling	**condensing**	**freezing**	**melting**

Change of state at **A**: _____

Change of state at **B**: _____

Question 2 continues on the next page

Table 1 shows the boiling points of the hydrocarbons in the fuel.

Table 1

Hydrocarbon	Boiling point in °C
Pentane	36
Hexane	69
Heptane	98
Octane	125

0 2 . 4 Which hydrocarbon will be the last to collect in the beaker?

[1 mark]

Tick **one** box.

Pentane ☐

Hexane ☐

Heptane ☐

Octane ☐

0 2 . 5 The fuel is a mixture of liquids that has been designed as a useful product.

What name is given to this type of mixture?

[1 mark]

Tick **one** box.

Catalyst ☐

Formulation ☐

Polymer ☐

Solvent ☐

0 2 . 6 Describe how this fuel is different from crude oil.

[2 marks]

0 2 . 7 A student measured the melting point of a solid hydrocarbon four times.

The student's results are in **Table 2**.

Table 2

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Melting point in °C	35	48	37	37

Calculate the mean melting point of the hydrocarbon, leaving out any anomalous result.

Give your answer to two significant figures.

[2 marks]

Mean melting point = _____ °C

Turn over for the next question

0 3 This question is about drinking water.

0 3 . 1 Name **two** methods of treating water from rivers, lakes or the sea to produce drinking water.

[2 marks]

Tick **two** boxes.

- Anaerobic digestion ☐
- Cracking ☐
- Desalination ☐
- Electrolysis ☐
- Sterilising ☐

Table 3 shows the amounts of dissolved ions in a sample of drinking water.

Table 3

Dissolved ion	Mass in mg per dm^3
Cl^-	250
Na^+	200
NO_3^-	40

0 3 . 2 What is the name of the ion with the symbol Cl^-?

[1 mark]

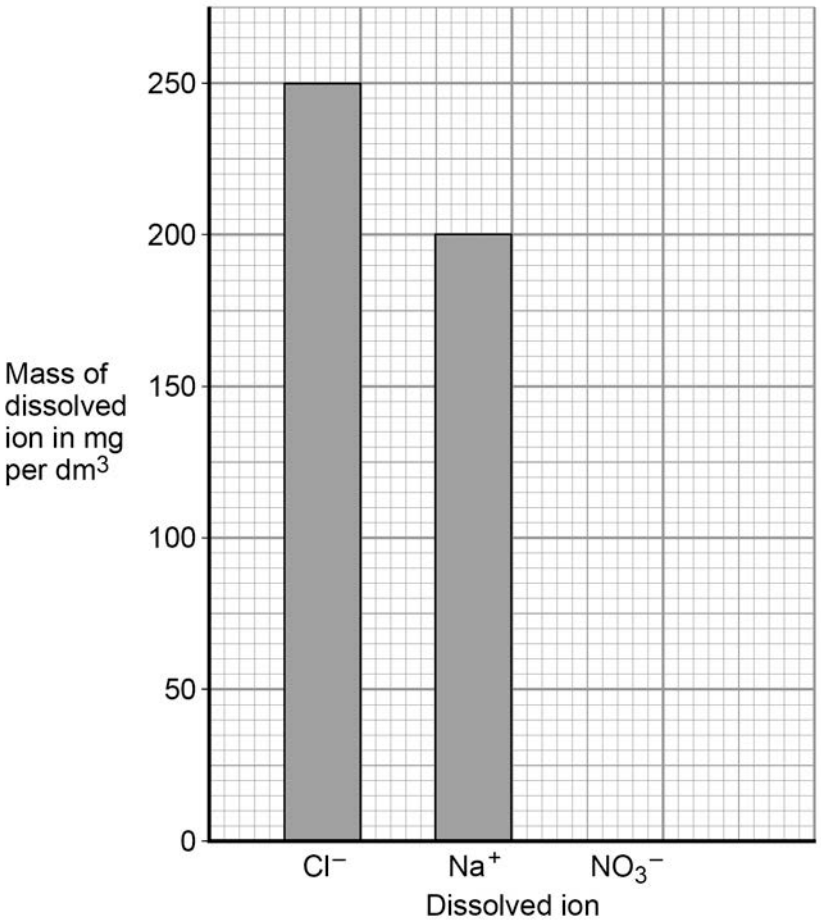
Tick **one** box.

- Calcium ion ☐
- Carbonate ion ☐
- Chloride ion ☐
- Chlorine ion ☐

0 3 . 3 Use the information in **Table 3** to complete the bar chart in **Figure 2**.

[1 mark]

Figure 2



Question 3 continues on the next page

Look at the questions labelled **A**, **B**, **C**, **D**.

A How many substances are there in drinking water?

B How much fluoride is in drinking water?

C Is fluoride soluble in drinking water?

D Should fluoride be added to drinking water?

0 3 . 4 Which **one** of the questions cannot be answered by science alone?

[1 mark]

Tick **one** box.

A		**B**		**C**		**D**	

0 3 . 5 Give **two** reasons why the answer you have chosen cannot be answered by science alone.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 6 A sample of drinking water contains 1.5 mg of fluoride per dm^3 of water.
A person drinks 1 dm^3 of this water.

The recommended daily amount of fluoride is 4.0 mg.

Which calculation gives the percentage of the recommended daily amount of fluoride in 1 dm^3 of this water?

[1 mark]

Tick **one** box.

$\frac{1.5}{4.0} \times 100$ ☐

$\frac{1.5}{100} \times 4.0$ ☐

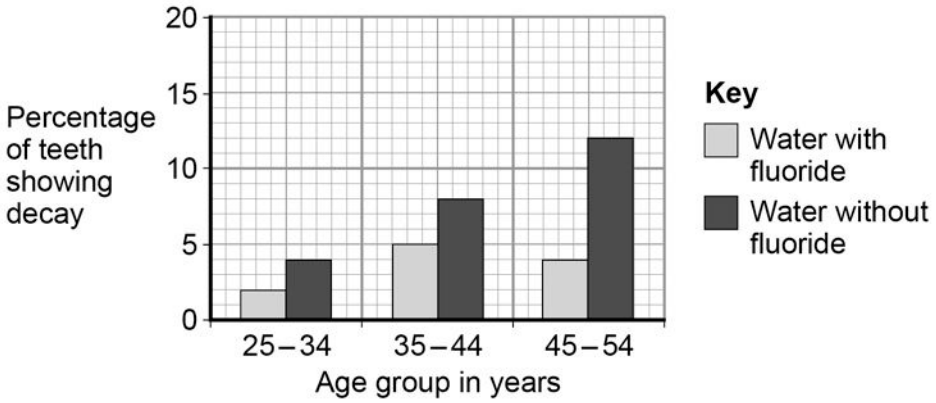
$\frac{4.0}{1.5} \times 100$ ☐

$\frac{100}{1.5 \times 4.0}$ ☐

Question 3 continues on the next page

Figure 3 shows the effect of fluoride in drinking water on tooth decay in different age groups.

Figure 3



0 3 . 7 Describe the pattern of tooth decay in **Figure 3** for water without fluoride.

Use data to justify your answer.

[2 marks]

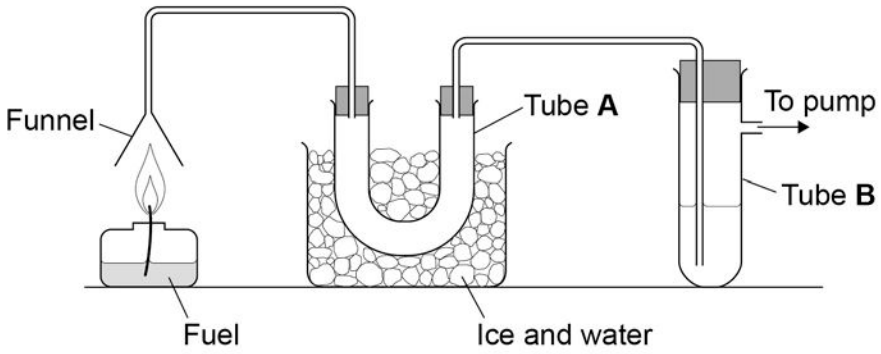
0 3 . 8 Describe the effect of adding fluoride to drinking water for the age groups in **Figure 3**.

[2 marks]

0 4 A student investigated the substances produced when fuels burn.

Figure 4 shows the apparatus the student used.

Figure 4



0 4 . 1 The complete combustion of a hydrocarbon produces carbon dioxide and **one** other substance.

Look at **Figure 4**. What would the student see in tube **A**?

[1 mark]

0 4 . 2 When the student burned the fuel she saw soot in the funnel.

Explain why soot forms.

[2 marks]

Question 4 continues on the next page

The student burned another fuel which contained impurities.

The substance in tube **B** is water containing universal indicator.

The indicator turned red.

0 4 . 3 Which gas made the indicator turn red?

[1 mark]

Tick **one** box.

Ammonia ☐

Carbon monoxide ☐

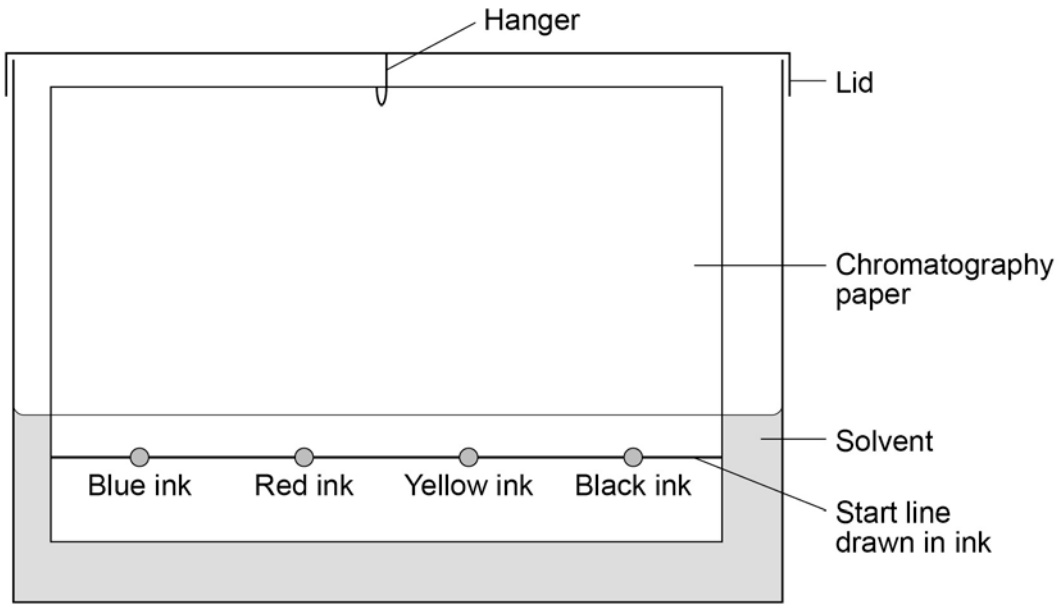
Nitrogen ☐

Sulfur dioxide ☐

0 5 A student used paper chromatography to investigate the colours in different inks.

Figure 5 shows the apparatus the student used.

Figure 5



0 5 . 1 The student made **two** mistakes in setting up the apparatus.

Identify the **two** mistakes.

Describe the problem each mistake would cause.

[4 marks]

Mistake 1 _____

Problem _____

_____

_____

Mistake 2 _____

Problem _____

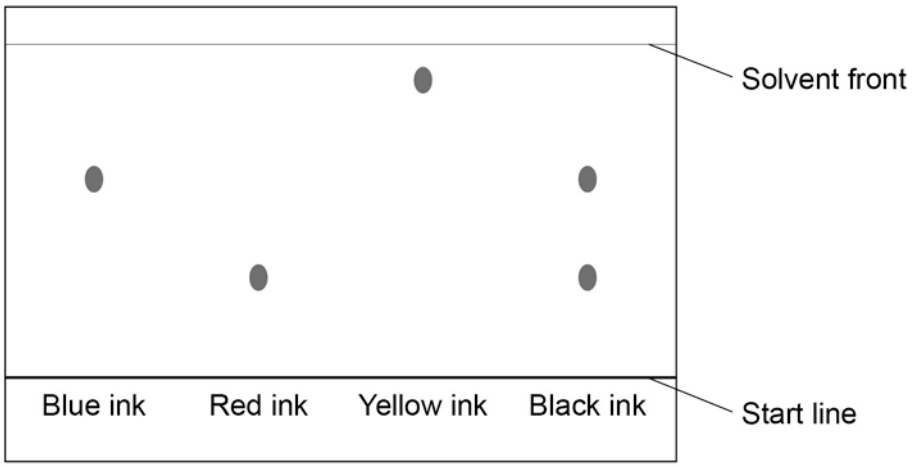
_____

_____

0 5 . 2 The student then set up the apparatus without making any mistakes.

Figure 6 shows his results.

Figure 6



What colours are in the black ink?

[1 mark]

0 5 . 3 Which of the inks is the most soluble in the solvent?

Give a reason for your answer.

[2 marks]

Ink

Reason

0 5 . 4 Use **Figure 6** to complete **Table 4**, then calculate the R_f value for red ink.

[5 marks]

Table 4

	Distance in mm
Distance moved by red ink	.....
Distance from start line to solvent front	.....

The R_f value for red ink is calculated using the equation.

$$R_f = \frac{\text{distance moved by red ink from the start line}}{\text{distance moved by solvent from the start line}}$$

Give your answer to two significant figures.

R_f value = _____

0 5 . 5 How can you tell from **Figure 6** that the R_f value for the blue ink is greater than the R_f value for the red ink?

[1 mark]

0 6 . 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 6 . 2 Describe the differences between cracking and distillation.

[2 marks]

0 6 . 3 What type of reaction is cracking?

[1 mark]

Tick **one** box.

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

0 6 . 4 Ethene is used to make poly(ethene).

Poly(ethene) is used to make plastic bags.

Table 5 shows data from a Life Cycle Assessment (LCA) for a plastic bag and a paper bag.

Table 5

	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

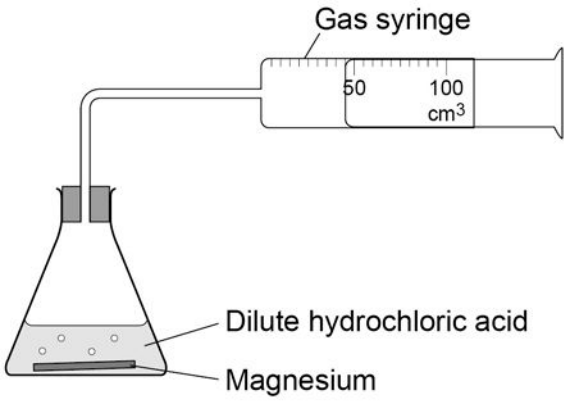
A company stated: 'A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags'.

Evaluate this statement. Use your knowledge and the information from **Table 5**.

[6 marks]

0 7 A student investigated the rate of the reaction between magnesium and dilute hydrochloric acid.
The student used the apparatus shown in **Figure 7** to collect the gas produced.

Figure 7



0 7 . 1 Outline a plan to investigate how the rate of this reaction changed when the concentration of the hydrochloric acid was changed.

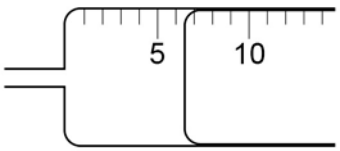
- Describe how you would do the investigation and the measurements you would make.
- Describe how you would make it a fair test.

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

[6 marks]

0 7 . 2 **Figure 8** shows the gas syringe during one of the experiments.

Figure 8



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 7 continues on the next page

0 7 . 3 **Figure 9** shows the student's results for one concentration of hydrochloric acid.

Figure 9

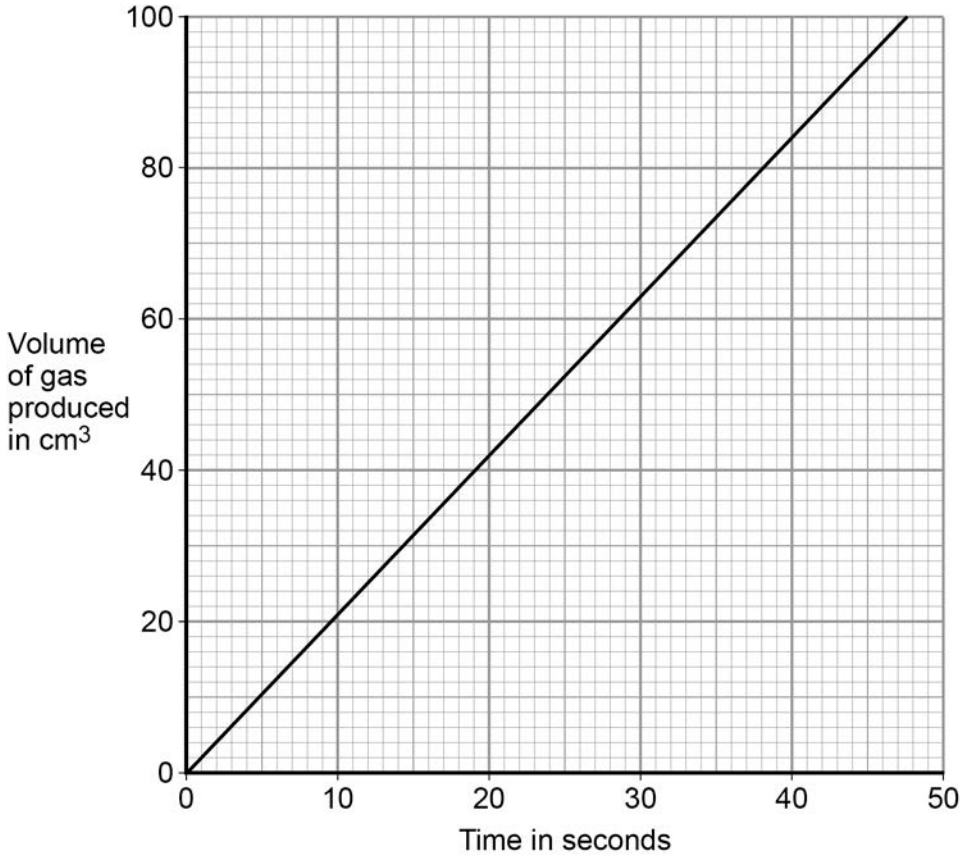


Table 6 shows the student's results when the concentration was two times greater than the results on **Figure 9**.

Table 6

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 6** on the grid in **Figure 9**.
Draw a line of best fit.

[3 marks]

0 7 . 4 Give **one** conclusion about how the rate of reaction changed when the concentration of hydrochloric acid was changed.

[1 mark]

END OF QUESTIONS