

Please write clearly in block capitals.

Centre number

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Forename(s)

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Candidate signature

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I declare this is my own work.

# GCSE COMBINED SCIENCE: TRILOGY

# F

Foundation Tier  
Chemistry Paper 2F

Tuesday 13 June 2023

Morning

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.

## 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.

| For Examiner's Use |      |
|--------------------|------|
| Question           | Mark |
| 1                  |      |
| 2                  |      |
| 3                  |      |
| 4                  |      |
| 5                  |      |
| 6                  |      |
| <b>TOTAL</b>       |      |



J U N 2 3 8 4 6 4 C 2 F 0 1

**0 1**

Crude oil contains a large number of hydrocarbons.

**0 1 . 1**

Crude oil is a finite resource.

What is a finite resource?

**[1 mark]**Tick (✓) **one** box.

A limited resource

A renewable resource

A sustainable resource

**0 1 . 2**

What is crude oil formed from?

**[1 mark]**Tick (✓) **one** box.

Plankton

Volcanoes

Water



**0 1 . 3** What type of substance is crude oil?

**[1 mark]**

Tick (✓) **one** box.

Compound

Element

Mixture

**0 1 . 4** The hydrocarbons in crude oil are separated into fractions using fractional distillation.

Complete the sentences.

Choose answers from the box.

**[2 marks]**

**condense**

**evaporate**

**freeze**

**melt**

In fractional distillation the crude oil is heated so

the hydrocarbons \_\_\_\_\_.

The fractions collect as the hydrocarbons cool and \_\_\_\_\_.

**Question 1 continues on the next page**

**Turn over ►**



Hydrocarbons can be cracked to produce more useful molecules.

**0 1 . 5** Complete the sentence.

Choose the answer from the box.

[1 mark]

alloys

fertilisers

fuels

Some products of cracking are useful as \_\_\_\_\_.

**0 1 . 6** Hydrogen gas is a product of cracking.

What is used in the test for hydrogen gas?

[1 mark]

Tick (✓) **one** box.

Burning splint

Glowing splint

Limewater



**0 1 . 7** 5.20 kg of crude oil contains 1.53 kg of LPG (Liquefied Petroleum Gas).

Calculate the percentage (%) of LPG in 5.20 kg of crude oil.

Give your answer to 3 significant figures.

**[3 marks]**

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Percentage (3 significant figures) = \_\_\_\_\_ %

**10**

**Turn over for the next question**

**Turn over ►**



0 2

The Earth's atmosphere is always changing.

0 2 . 1

Gases in the Earth's early atmosphere caused changes on the Earth.

Draw **one** line from each change to the gas that caused the change.

**[2 marks]****Change****Gas that caused the  
change**

Oceans formed

Ammonia

Carbon dioxide

Nitrogen

Sedimentary rocks formed

Oxygen

Water vapour



**Table 1** shows the percentage of some gases in the atmospheres of Earth and Mars today.

**Table 1**

| Gas            | Percentage of gas in atmosphere (%) |      |
|----------------|-------------------------------------|------|
|                | Earth                               | Mars |
| Argon          | 0.90                                | 1.9  |
| Carbon dioxide | 0.04                                | 95   |
| Nitrogen       | 78                                  | 2.6  |
| Oxygen         | 21                                  | 0.20 |

**0 2 . 2** Which gas has the highest percentage in the Earth's atmosphere?

**[1 mark]**

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**0 2 . 3** Calculate how many times more carbon dioxide there is in the atmosphere of Mars than in the atmosphere of Earth.

Use **Table 1**.

Give your answer in standard form.

**[3 marks]**

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Number of times more carbon dioxide (in standard form) = \_\_\_\_\_

**Turn over ►**



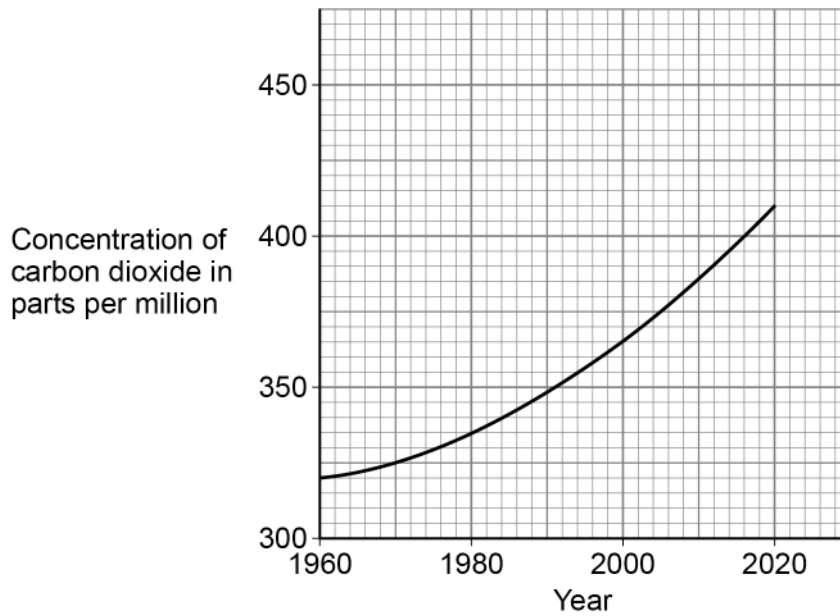
Carbon dioxide is a greenhouse gas.

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0 2 . 4

**Figure 1** shows the concentration of carbon dioxide in the Earth's atmosphere from 1960 to 2020.

**Figure 1**



How has the concentration of carbon dioxide in the Earth's atmosphere changed from 1960 to 2020?

**[1 mark]**

Tick (✓) **one** box.

Decreased

Stayed the same

Increased





**0 2 . 5** Cars emit carbon dioxide.

A car emits 17.2 kg of carbon dioxide on a journey.

There are four people in the car.

Calculate the mass of carbon dioxide emitted per person.

**[2 marks]**

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Mass of carbon dioxide = \_\_\_\_\_ kg

**0 2 . 6** Planting trees helps to reduce climate change, because trees use carbon dioxide from the Earth's atmosphere.

Name the process in trees which uses carbon dioxide.

**[1 mark]**

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**Question 2 continues on the next page**

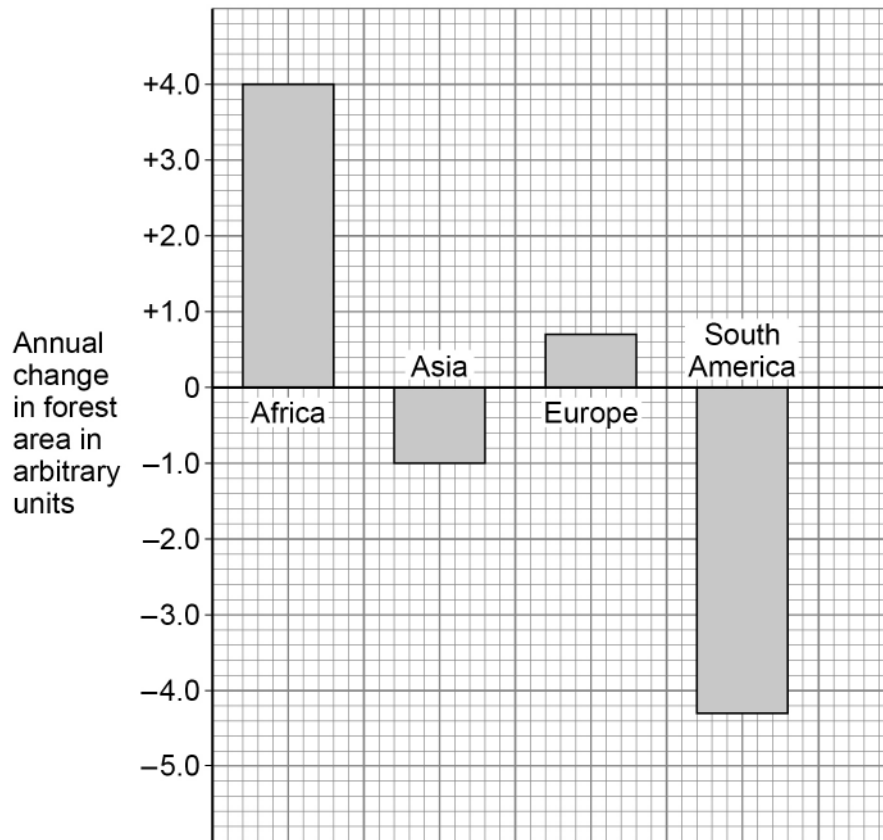
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0 2 . 7

Figure 2 shows the annual change in forest area in four different parts of the world.

Figure 2



Give **two** conclusions about the annual change in forest area.

[2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

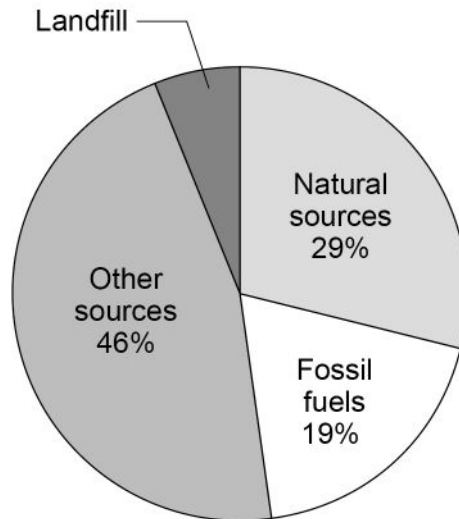
\_\_\_\_\_



0 2 . 8 Methane is a greenhouse gas.

Figure 3 shows sources of methane emissions.

Figure 3



Determine the percentage (%) of methane emissions from landfill.

[1 mark]

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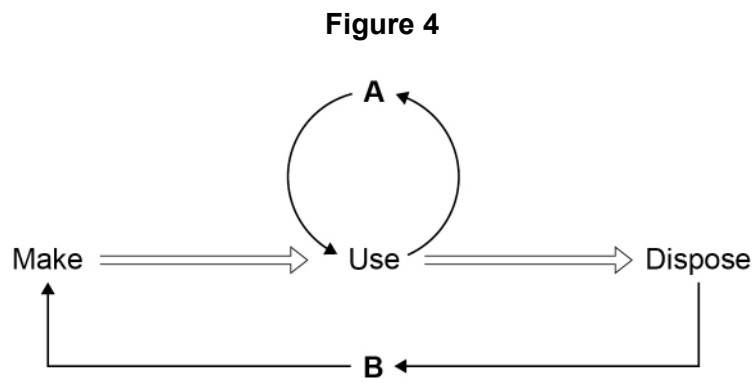
Percentage = \_\_\_\_\_ %

Question 2 continues on the next page

Turn over ►



**0 2 . 9** Figure 4 shows two ways (A and B) of preventing used items going to landfill.



Name **A** and **B**.

Choose answers from the box.

**[2 marks]**

recycle

reduce

release

reuse

reverse

**A** \_\_\_\_\_

**B** \_\_\_\_\_

15



**Turn over for the next question**

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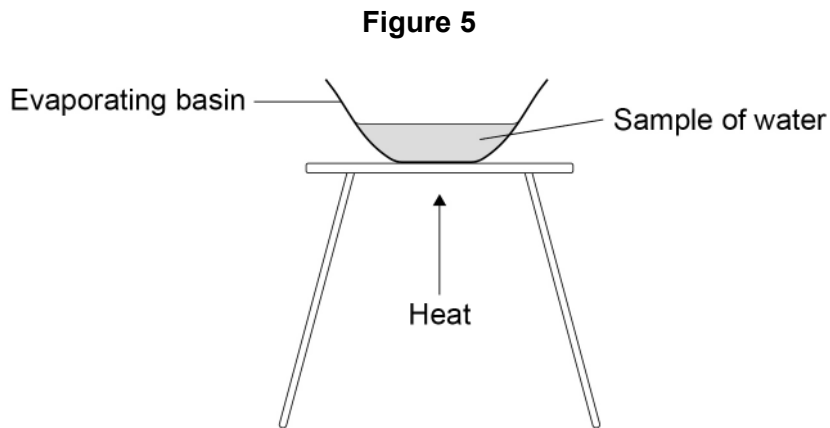


**0 3**

Some types of water contain dissolved substances.

A student investigated the mass of dissolved solids in distilled water and in sea water.

**Figure 5** shows the apparatus.



This is the method used.

1. Weigh an evaporating basin.
2. Add a sample of distilled water to the evaporating basin.
3. Weigh the evaporating basin and the water sample.
4. Heat the water sample.
5. Weigh the evaporating basin and contents.
6. Repeat steps 1 to 5 two more times.
7. Repeat steps 1 to 6 with sea water.

**0 3****. 1**

Give **one** safety precaution the student should take.

**[1 mark]**

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0 3 . 2

The method used did **not** give valid results.

Which **two** improvements could the student make to give valid results?

[2 marks]

Tick (✓) **two** boxes.

Heat until the mass of the evaporating basin and contents does not change.

Leave some water in the evaporating basin after heating.

Record the results in a table and plot a bar graph.

Use 25 cm<sup>3</sup> of water for each experiment.

Use a beaker instead of an evaporating basin.

0 3 . 3

A different student used a method which gave valid results.

**Table 2** shows the results.

**Table 2**

| Type of water   | Mass of dissolved solids in grams |        |        |
|-----------------|-----------------------------------|--------|--------|
|                 | Test 1                            | Test 2 | Test 3 |
| Distilled water | 0.00                              | 0.00   | 0.00   |
| Sea water       | 0.31                              | 0.32   | 0.27   |

The student concludes that distilled water is pure.

Suggest **one** reason why.

[1 mark]

---



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Turn over ►



Tap water is potable.

One step in producing potable water is sterilisation.

**0 3 . 4** Why is potable water sterilised?

**[1 mark]**

Tick (✓) **one** box.

To improve the taste

To kill bacteria

To remove dissolved solids

**0 3 . 5** Chlorine is used to sterilise water.

The reaction between chlorine and water is reversible.

Complete the sentence.

**[1 mark]**

Equilibrium is reached when the forward and reverse reactions  
occur at the same \_\_\_\_\_.

**0 3 . 6** The test for chlorine uses damp litmus paper.

Complete the sentence.

Choose the answer from the box.

**[1 mark]**

**blue**

**green**

**white**

When damp litmus paper is put into chlorine gas

the litmus paper turns \_\_\_\_\_.

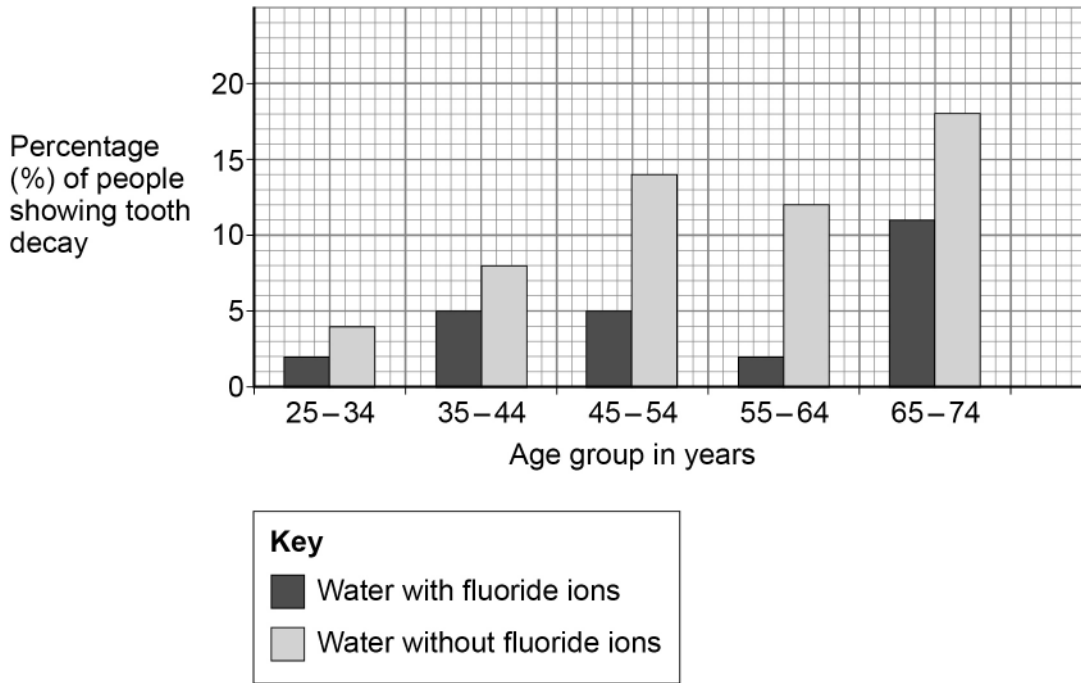




There is evidence that adding fluoride ions to drinking water reduces tooth decay.

**Figure 6** shows the percentage of people showing tooth decay.

**Figure 6**



0 3 . 7

Compare the effects of adding fluoride ions to drinking water on tooth decay in people between the ages of 25 and 74.

Use data from **Figure 6**.

**[4 marks]**

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Turn over ►



03.8

Student **A** says that water companies should add fluoride ions to all drinking water.

Student **B** disagrees.

Suggest **one** reason why Student **B** may think that fluoride ions should **not** be added to all drinking water.

[1 mark]

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12



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**0 4**

A catalyst is used to increase the rate of decomposition of hydrogen peroxide.

**0 4 . 1**

Hydrogen peroxide decomposes to produce water and oxygen.

Write a word equation for the reaction.

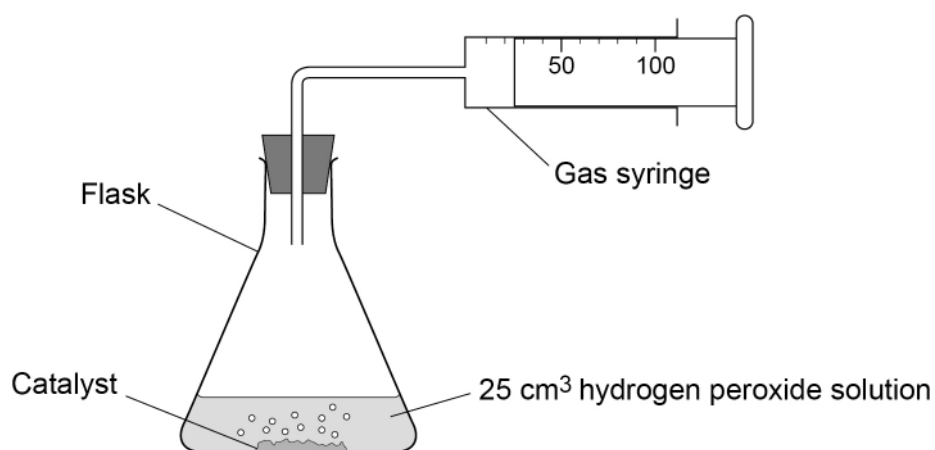
**[1 mark]**

\_\_\_\_\_ → \_\_\_\_\_ + \_\_\_\_\_

A student investigated the rate of decomposition of hydrogen peroxide using three different catalysts:

- manganese dioxide
- copper oxide
- zinc oxide.

**Figure 7** shows the apparatus.

**Figure 7**

This is the method used.

1. Measure 25 cm<sup>3</sup> of hydrogen peroxide solution into a flask.
2. Add 0.5 g of manganese dioxide catalyst to the flask.
3. Attach a gas syringe to the flask.
4. Measure the volume of oxygen produced every 20 seconds for 120 seconds.
5. Repeat steps 1 to 4 two more times.
6. Repeat steps 1 to 5 using copper oxide catalyst.
7. Repeat steps 1 to 5 using zinc oxide catalyst.

**0 4 . 2** Which **two** control variables are used in the investigation?

**[2 marks]**

Tick (✓) **two** boxes.

Mass of catalyst

Shape of flask

Time of taking readings

Volume of hydrogen peroxide solution

Volume of oxygen produced

**Question 4 continues on the next page**

**Turn over ►**



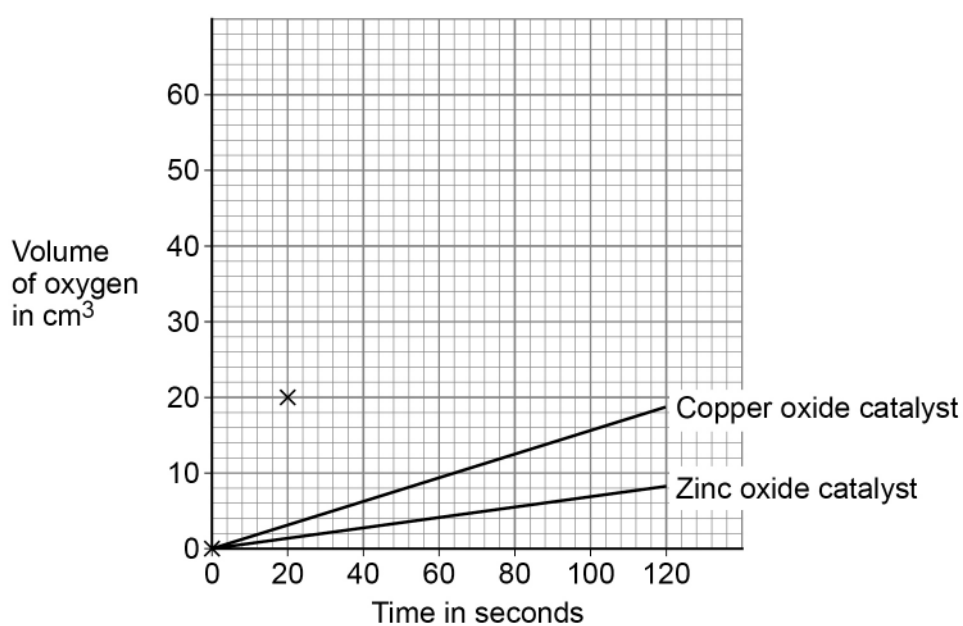
**Table 3** shows the results with manganese dioxide catalyst.

**Table 3**

|   |   |    |    |    |    |     |     |
|---|---|----|----|----|----|-----|-----|
| <b>Time in seconds</b>                    | 0 | 20 | 40 | 60 | 80 | 100 | 120 |
| <b>Volume of oxygen in cm<sup>3</sup></b> | 0 | 20 | 32 | 40 | 45 | 49  | 50  |

**Figure 8** shows a graph of the results with copper oxide catalyst and with zinc oxide catalyst.

**Figure 8**



**0 4 . 3** Complete **Figure 8**.

You should:

- plot the data for the manganese dioxide catalyst from **Table 3**
- draw a line of best fit.

The first two points have been plotted for you.

**[3 marks]**



0 4 . 4 Which is the best catalyst?

Give **one** reason for your answer.

Use the completed **Figure 8**.

[2 marks]

Tick (✓) **one** box.

Copper oxide

Manganese dioxide

Zinc oxide

Reason \_\_\_\_\_  
\_\_\_\_\_

0 4 . 5 The student repeated the investigation with manganese dioxide catalyst.

The results were all close to the true value.

Complete the sentence.

Choose the answer from the box.

[1 mark]

accurate

approximate

random

Results that are close to the true value are \_\_\_\_\_.

**Question 4 continues on the next page**

Turn over ►



0 4 . 6

The student repeated the investigation using manganese dioxide catalyst at a higher temperature.

Complete the sentence.

Choose the answer from the box.

[1 mark]

decrease

stay the same

increase

At a higher temperature, the rate of reaction will \_\_\_\_\_.

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0 5

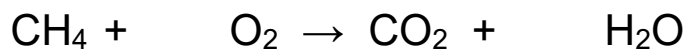
The combustion of fuels is a source of atmospheric pollutants.

0 5 . 1

Methane is a fuel.

Balance the equation for the combustion of methane.

[1 mark]



0 5 . 2

Many fuels are mixtures.

Petrol and diesel are mixtures of hydrocarbons.

**Table 4** shows properties of petrol and of diesel.

**Table 4**

|   | Petrol    | Diesel     |
|---|-----------|------------|
| Range of number of carbon atoms in a hydrocarbon molecule | 4 to 12   | 12 to 20   |
| Range of boiling points in °C                             | 40 to 205 | 250 to 350 |

Compare the properties of petrol and diesel.

Use **Table 4**.

[2 marks]

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Turn over ►



**0 5 . 3** The gases released when a fuel is burned in car engines may include:

- oxides of nitrogen
- carbon monoxide
- water vapour.

Which chemical element do all these gases contain?

**[1 mark]**

Tick (✓) **one** box.

Carbon

Hydrogen

Nitrogen

Oxygen

**0 5 . 4** When diesel burns in car engines, oxides of nitrogen are produced.

Where does the nitrogen come from?

**[1 mark]**

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**0 5 . 5** When diesel burns, particulates may be produced.

What environmental effect do particulates from burning diesel cause?

**[1 mark]**

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**0 5 . 6** Carbon monoxide may be produced when diesel burns.

Give **one** reason why carbon monoxide is difficult to detect.

[1 mark]

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**0 5 . 7** Explain why water vapour and **not** liquid water is produced when diesel burns.

[2 marks]

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**0 5 . 8** Sulfur is a common impurity in diesel.

Explain why this causes an environmental problem.

[3 marks]

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Turn over for the next question

Turn over ►



0 6

Chromatography is used to separate mixtures.

Chromatography involves a mobile phase and one other phase.

0 6 . 1

What is the other phase in chromatography?

**[1 mark]**

Tick (✓) **one** box.

Moving phase

Recycled phase

Stationary phase

Viscous phase

0 6 . 2

Why do the substances in the mixture separate in the mobile phase?

**[1 mark]**

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0 6 . 3

How many spots will be produced on the chromatogram of a pure compound?

**[1 mark]**

Number of spots = \_\_\_\_\_



**0 6 . 4** In a chromatography experiment, a blue colour moved 4.77 cm.

The solvent moved 5.30 cm.

Calculate the  $R_f$  value for the blue colour.

**[2 marks]**

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$R_f$  value = \_\_\_\_\_

**Question 6 continues on the next page**

**Turn over ►**



**0 6** . **5** Black ink is a mixture of several colours.

Plan an experiment using paper chromatography to:

- separate the colours in black ink
- identify the colours from their  $R_f$  values.

**[6 marks]**

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**11**

**END OF QUESTIONS**



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3 6



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