OCR
Oxford Cambridge and RSA

F

Wednesday 12 June 2019 – Morning

GCSE (9–1) Chemistry A (Gateway Science)

J248/02 Paper 2 (Foundation Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Chemistry A (inserted))

You may use:
- a scientific or graphical calculator
- an HB pencil

J248802

Please write clearly in black ink. **Do not write in the barcodes.**

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

First name(s) _____

Last name _____

INSTRUCTIONS
- The data sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

SECTION A

You should spend a maximum of 30 minutes on this section.

Answer **all** the questions.

Write your answer to each question in the box provided.

1 Which type of water is **potable** water?

A Groundwater

B Seawater

C Tap water

D Waste water

Your answer ☐ **[1]**

2 Which of these elements is a **transition metal**?

A Calcium

B Caesium

C Carbon

D Cobalt

Your answer ☐ **[1]**

3 Lithium, sodium and potassium all react with water.

In all three reactions the same gas is produced.

What is the name of the gas?

A Carbon dioxide

B Chlorine

C Hydrogen

D Oxygen

Your answer ☐ **[1]**

4 The rate of a reaction can be changed by adding a catalyst to the reaction mixture.

Which line of the table shows how the **rate of reaction** and the **mass of the catalyst** change as the reaction takes place?

	Change in rate of reaction	Change in mass of catalyst
A	decreases	no change
B	no change	decreases
C	increases	no change
D	increases	decreases

Your answer ☐ **[1]**

5 How was the Earth's early atmosphere formed?

A Animals breathing

B Global warming

C Plants growing

D Volcanic activity

Your answer ☐ **[1]**

6 Crude oil is a mixture of hydrocarbons.

Crude oil is separated into useful fractions.

Which of these mixtures of substances could be in a fraction from crude oil?

A C_2H_4, C_4H_{10}, $C_4H_{10}O$

B C_2H_4, C_2H_3Br, C_4H_{10}

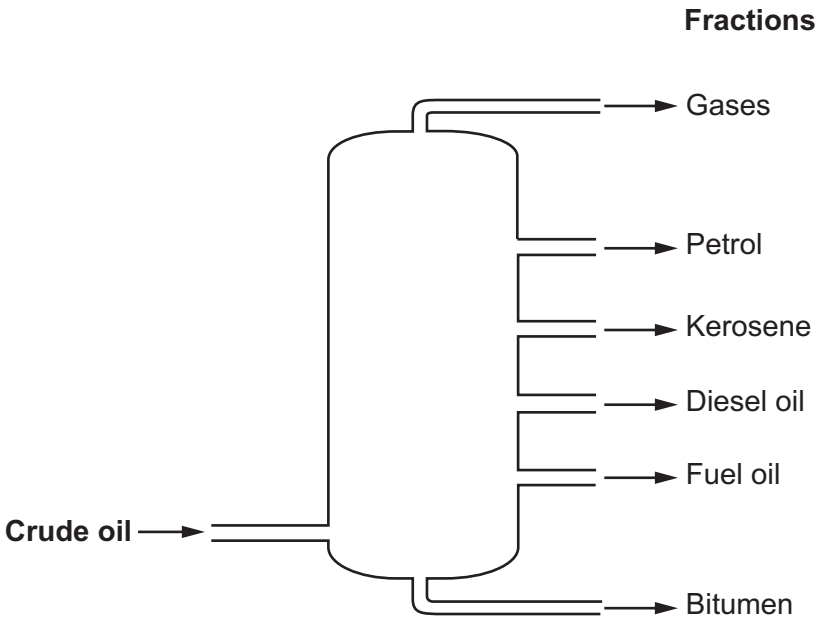
C C_2H_6, C_3H_8, C_4H_{10}

D C_2H_6, C_2H_3Br, $C_4H_{10}O$

Your answer ☐ **[1]**

7 Crude oil is separated into useful fractions by fractional distillation.

The diagram shows the useful fractions made in fractional distillation.



Which of these fractions has the **weakest** intermolecular forces?

A Bitumen

B Diesel oil

C Gases

D Petrol

Your answer ☐ **[1]**

8 What type of reaction takes place between an alkene and hydrogen?

A Addition

B Dehydration

C Neutralisation

D Thermal decomposition

Your answer ☐ **[1]**

9 The table shows the main stages in the life-cycle assessment of a manufactured product.

Stage	Process
1	Manufacturing the product
2	Obtaining raw materials
3	Disposing of the product
4	Using the product

What is the correct order for the stages?

A 1, 2, 3, 4

B 1, 2, 4, 3

C 2, 1, 4, 3

D 2, 4, 1, 3

Your answer ☐ **[1]**

10 The Haber process is used to make ammonia, NH_3.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

What is the raw material for the **nitrogen**?

A Air

B Hydrochloric acid

C Natural gas

D Seawater

Your answer ☐ **[1]**

11 Which statement describes the test for **chlorine gas**?

A A lighted splint makes a squeaky pop.

B Limewater turns milky.

C A glowing splint re-lights.

D Damp litmus paper is bleached.

Your answer ☐ **[1]**

12 Which statement describes the **atom economy** of a reaction?

A A measure of how many atoms in the reactants form the waste products.

B A measure of how many atoms in the reactants form the desired product.

C A measure of the actual yield of product compared to the predicted yield of product.

D A measure of how many atoms form waste products compared to desired products.

Your answer ☐ **[1]**

13 Which statement describes the properties of **transition metals**?

A High melting point, shiny when freshly cut and brittle.

B Good conductors of electricity, low density and low melting point.

C Good conductors of electricity, strong and malleable.

D Strong, malleable and low density.

Your answer ☐ **[1]**

14 Which statement describes the **advantages** of instrumental methods of analysis?

A Instruments can analyse very small amounts and carry out the analyses slowly.

B Instruments are very accurate and use large amounts of substances.

C Instruments are very accurate and carry out the analyses slowly.

D Instruments are very accurate and can run all the time.

Your answer ☐ **[1]**

15 The table shows the composition of the Earth's early atmosphere compared with the atmosphere today.

	Nitrogen	**Oxygen**	**Argon**	**Carbon dioxide**
Percentage of gas in the early atmosphere	4	0.5	0.5	95
Percentage of gas in the atmosphere today	78	21	0.9	0.04

Which gas has **changed by the largest percentage** from the early atmosphere to the atmosphere today?

A Nitrogen

B Oxygen

C Argon

D Carbon dioxide

Your answer ☐ **[1]**

SECTION B

Answer **all** the questions.

16 This question is about the corrosion of metals.

(a) A student investigates the rusting of iron.

Fig. 16.1 shows the experiments she sets up.

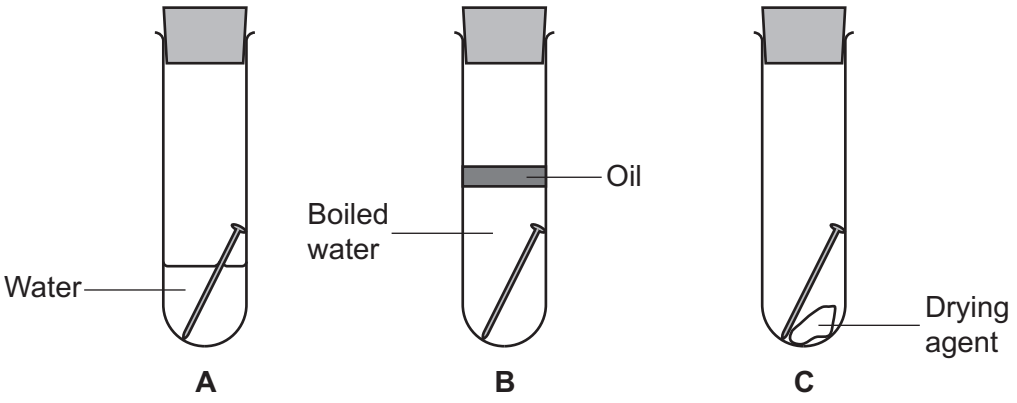


Fig. 16.1

Write about what the student would observe in each tube after one week.

Explain the observations.

Tube **A** .....

.....

Tube **B** .....

.....

Tube **C** .....

.....

[3]

(b) Another student buys a new bicycle. The bicycle chain is made of iron.

The student decides to oil the chain to prevent it from rusting, as shown in **Fig. 16.2**.

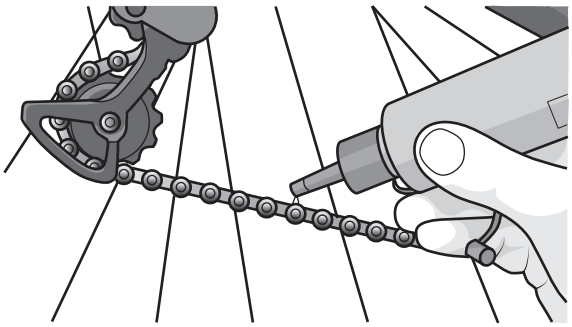


Fig. 16.2

Explain why oiling the chain will prevent the iron from rusting.

.....

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..... **[2]**

(c) A galvanised iron bucket is made of iron coated with a layer of zinc.

After years of use, the zinc coating has become scratched.

The iron below the zinc has been exposed but the iron has not rusted.

Explain why the iron has not rusted.

.....

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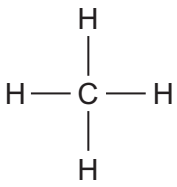
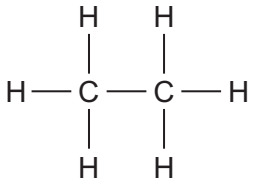
..... **[2]**

17 This question is about hydrocarbons.

The table shows some information about alkanes.

Name of alkane	Molecular formula	Structure
Methane	CH_4	
Ethane	.....	
.....	C_4H_{10}	.....

(a) Complete the table. **[3]**

(b) Ethane is a **saturated hydrocarbon**.

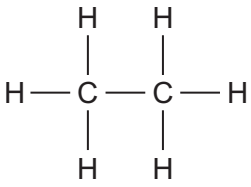
Explain why ethane is called both a hydrocarbon **and** saturated.

.....

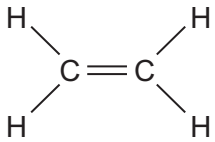
.....

..... **[2]**

(c) A student has two test tubes. One contains **ethane** and one contains **ethene**.



Ethane



Ethene

The student added **bromine water** to each test tube.

Describe what she observes.

Ethane .....

Ethene .....

[2]

(d) Ethane belongs to the **homologous series** called the alkanes.

What is the name of the homologous series that **ethene** belongs to?

..... **[1]**

(e) Pentane, C_5H_{12}, is an alkane found in petrol.

Pentane undergoes **complete combustion** in excess oxygen, O_2.

Carbon dioxide and water are made.

Write the **balanced symbol** equation for the complete combustion of pentane.

..... **[2]**

18 This question is about the extraction of metals.

(a) When iron oxide is heated with carbon, iron is made.

(i) Complete the **word equation** for this reaction.

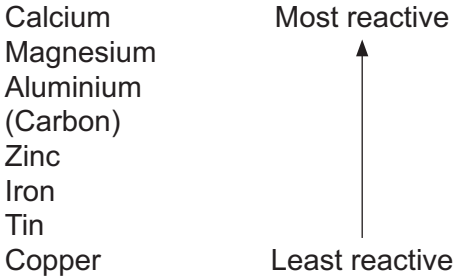
iron oxide + carbon → ..... + ... **[1]**

(ii) Iron oxide is **reduced** during this reaction.

Explain how you can tell that iron oxide is reduced.

..... **[1]**

(b) Look at the reactivity series of some metals. Carbon is also included.



(i) Zinc is usually extracted from zinc oxide by **heating zinc oxide with carbon**.

Explain why. Use the reactivity series to help you.

..... **[1]**

(ii) Aluminium is extracted from aluminium oxide by **electrolysis**.

Explain why. Use the reactivity series to help you.

..... **[1]**

(c) The table shows some information about aluminium and zinc.

Metal	Cost of 1 kg (£)	Amount in Earth's crust (%)
Aluminium	1.31	8.1
Zinc	2.51	0.0078

Suggest **two** reasons why it could be more important to recycle zinc than aluminium.

Use information from the table to help you.

1 .....

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2 .....

.....

[2]

(d) Aluminium alloys are often used to build aircraft.

A sample of an aluminium alloy contains 1.28 g of magnesium and 43.70 g of aluminium only.

Calculate the **percentage of magnesium** in this alloy.

Give your answer to **3** significant figures.

Percentage of magnesium = ... % **[4]**

19 The Haber process is used to make ammonia, NH_3.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

(a) The reaction reaches a **dynamic equilibrium**.

(i) What happens to the **rate** of the forward and backward reactions at dynamic equilibrium?

..... **[1]**

(ii) What happens to the **concentrations** of the reacting substances at equilibrium?

..... **[1]**

(b) Ammonia is used to make fertilisers.

Fertilisers usually contain nitrogen.

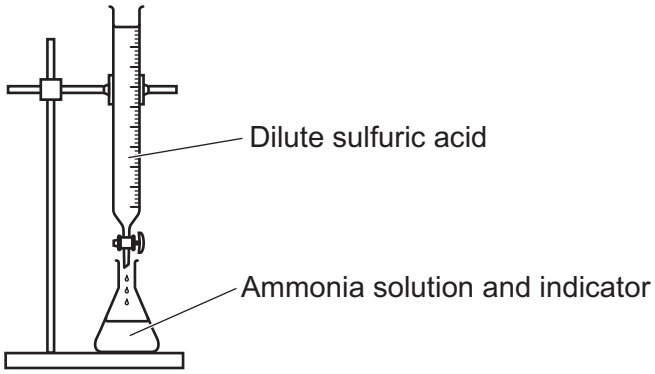
Name the **two** other elements that fertilisers usually contain.

..... **and** ..... **[2]**

(c) Ammonium sulfate is a salt used as a fertiliser.

Ammonium sulfate can be made in a laboratory in a batch process.

Ammonia solution is titrated with dilute sulfuric acid to make a solution of ammonium sulfate, as shown in the diagram.



Describe how you would make **dry crystals** of ammonium sulfate from ammonium sulfate solution.

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..... **[2]**

(d) Calcium sulfate is another salt.

A student made some calcium sulfate.

Look at the method he used:

- pour 100 cm^3 of calcium nitrate solution into a beaker
- add drops of sodium sulfate solution until a precipitate appears
- allow the precipitate to settle to the bottom of the beaker
- pour off the liquid
- use a spatula to transfer the solid calcium sulfate onto a piece of filter paper.

Describe and explain **two** ways that the student could improve his method to **increase** the amount of **pure**, **dry** calcium sulfate made.

1 .....

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2 .....

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[4]

20 Crude oil is separated into useful fractions using fractional distillation.

The table shows the percentages of crude oil fractions from different oil wells.

Fraction	Percentage of fraction in crude oil		
	Oil well X	Oil well Y	Oil well Z
LPG	2	7	10
Petrol	3	10	25
Paraffin	6	15	20
Diesel	7	11	15
Fuel oil	26	29	28
Bitumen	56	28	2

(a) Which oil well contains the highest percentage of low boiling point fractions?

Tick (✓) **one** box.

X ☐

Y ☐

Z ☐

[1]

(b) A barrel of crude oil from oil well **Y** has a mass of 139 kg.

Calculate the mass of **fuel oil** in this barrel.

Mass = ... kg **[2]**

(c) Fractions from crude oil contain alkanes.

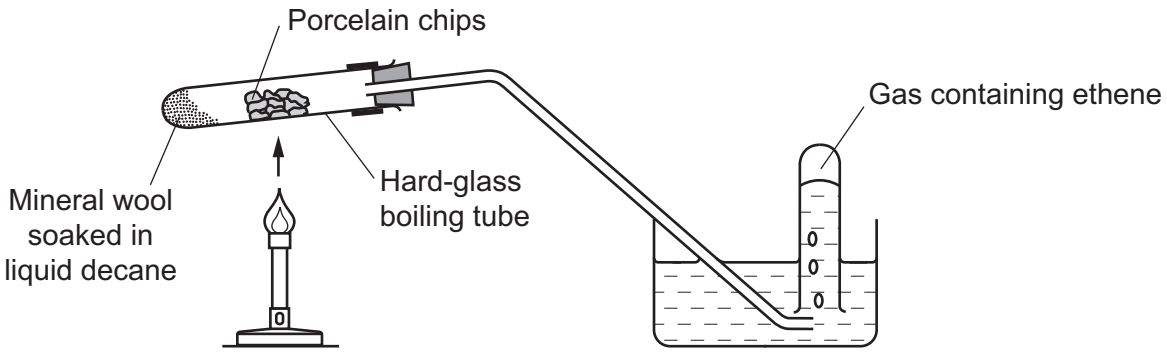
Alkanes have the general formula C_nH_{2n+2}.

Write the **formula** of hexadecane, the alkane with 16 carbon atoms.

..... **[1]**

(d) A sample of decane was cracked.

Look at the diagram of the apparatus used.



(i) Describe how this apparatus is used to produce ethene from decane.

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..... **[2]**

(ii) One molecule of decane, $C_{10}H_{22}$, produced two molecules of ethene, C_2H_4, and one molecule of product **Z**.

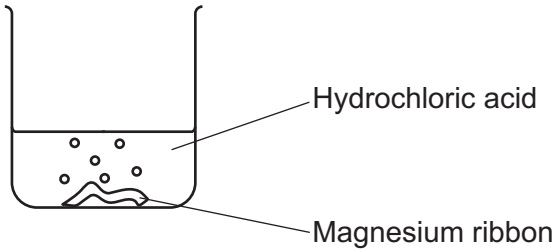
$C_{10}H_{22} \rightarrow 2C_2H_4$ + product **Z**

Write the **formula** for product **Z**.

..... **[1]**

21 A student investigates the reaction between magnesium and dilute hydrochloric acid, HCl.

The student adds magnesium ribbon to hydrochloric acid in a beaker, as shown in the diagram.



Magnesium chloride, MgCl_2, and hydrogen gas are made.

(a) Write the **balanced symbol** equation for this reaction.

..... **[2]**

(b)* The student measures the time it takes for all the magnesium to react. This is the reaction time.

The student does five experiments.

This is the student's prediction:

"The smaller the volume of acid and the smaller the mass of magnesium, the shorter the reaction time."

Look at the student's results.

Experiment	Mass of magnesium used (g)	Volume of acid used (cm^3)	Concentration of acid (mol/dm^3)	Reaction time (s)
1	0.05	25	1.0	30
2	0.05	50	1.0	30
3	0.05	50	2.0	15
4	0.10	25	1.0	30
5	0.10	50	2.0	15

Describe and explain whether the student's results support his prediction.

Include ideas about the reacting particle model in your answer.

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..... **[6]**

(c) The student repeats experiment **1**. This time he uses acid at a **lower** temperature.

Explain, using the reacting particle model, **what happens to the rate of reaction** and **predict the reaction time** for this reaction.

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..... **[3]**

(d) During chemical reactions, reactants are used up and the rate of reaction **decreases**.

Explain, in terms of particles, why the rate of reaction decreases.

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..... **[2]**

22 This question is about properties of materials.

Police bullet-resistant vests could be made from steel or Kevlar®.

The table shows some information about steel and Kevlar®.

	Steel	**Kevlar®**
Density (g / cm^3)	7.85	1.44
Relative strength	1	5
Flexibility	low	high
Resistance to corrosion	low	high

(a) Describe and explain **two** reasons why bullet-resistant vests are made from Kevlar® instead of steel.

1 .....

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2 .....

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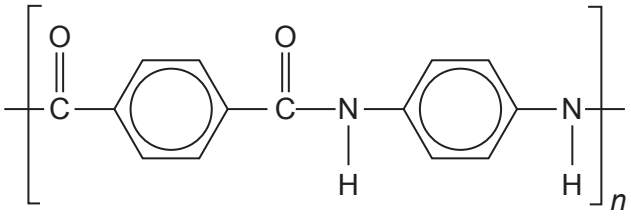
.....

[4]

(b) Look at the structure of Kevlar®.



What type of molecule is Kevlar®?

..... **[1]**

(c) Nanoparticles are being used to make a material that is better than Kevlar® at resisting bullets.

Nanoparticles are often made of silicon dioxide.

A silicon dioxide nanoparticle has a diameter of 18 nm.

The diameter of a silicon atom is 0.22 nm.

(i) Estimate how many times larger the silicon dioxide nanoparticle is, compared to a silicon atom.

Give your answer to **1** significant figure.

Number of times larger = ... **[3]**

(ii) Silicon dioxide is used as a **catalyst**.

Suggest why 1 g of silicon dioxide is **more effective** as a catalyst when used as nanoparticles rather than as a powder.

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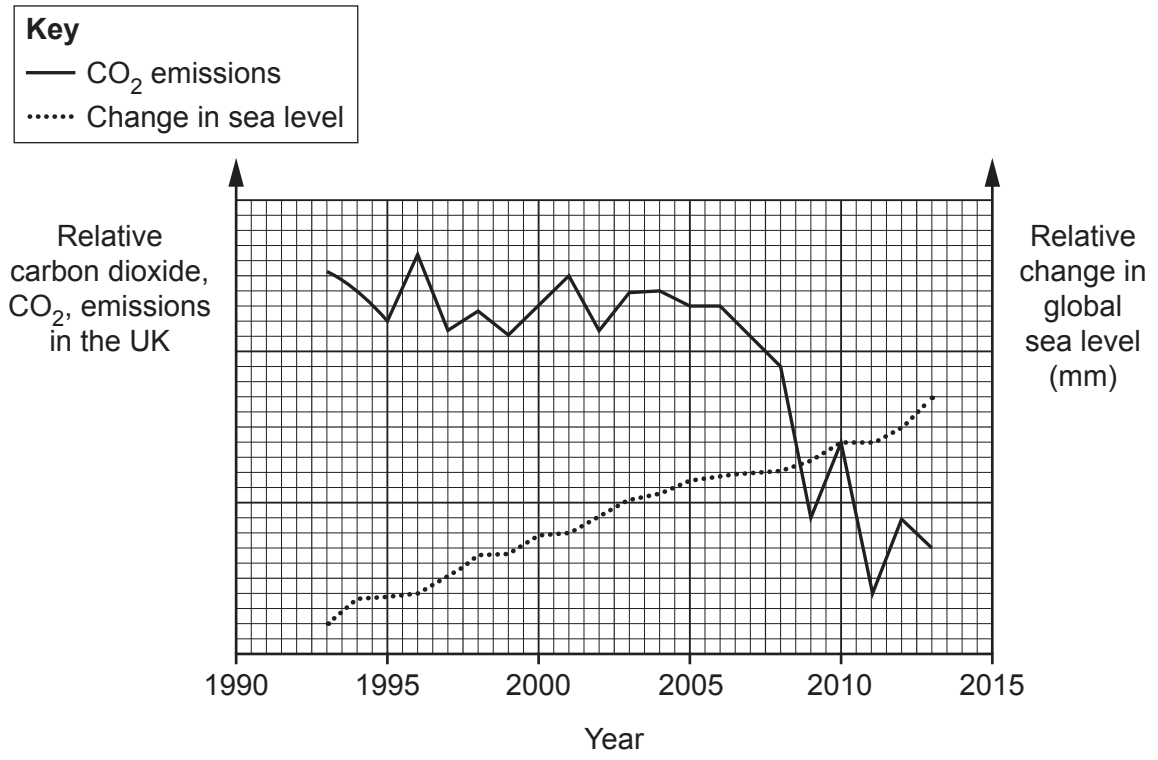
..... **[3]**

23 Some scientists believe that the increased burning of fossil fuels has contributed to global warming.

The scientists say that global warming is causing ice to melt, which results in sea levels rising.

Other scientists believe that rises in global temperatures are just natural variations.

The graph shows the carbon dioxide, CO_2, emissions by fossil fuels in the UK and the changes in global sea levels between 1993 and 2013.



(a) Evaluate the information shown in the graph.

To what extent does the graph support a link between human activity and global warming?

.....

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..... **[3]**

(b) There are problems with using information about **CO_2 emissions by fossil fuels** to draw conclusions about the effect of carbon dioxide emissions on **global** sea levels.

Suggest what these problems are.

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.....

..... **[2]**

(c) **(i)** Describe **one** effect on the Earth's climate of increased carbon dioxide levels, other than rising sea levels.

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..... **[1]**

(ii) Suggest how we can lower carbon dioxide levels.

.....

..... **[1]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).