

GCSE (9–1) Chemistry B (Twenty First Century Science)

F

J258/02 Depth in chemistry (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2.3

Time allowed: 1 hour 45 minutes

You must have:

- a ruler (cm/mm)
- the Data Sheet

You may use:

- a scientific or graphical calculator



First name

Last name

Centre
number

Candidate
number

INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

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.

Answer **all** the questions.

1 Extreme Weather Events

Extreme weather events make big news all over the world. Floods and storms have killed and injured many people around the world and caused massive damage to populated cities in recent years.

Fig. 1.1 shows the trend in extreme weather events.

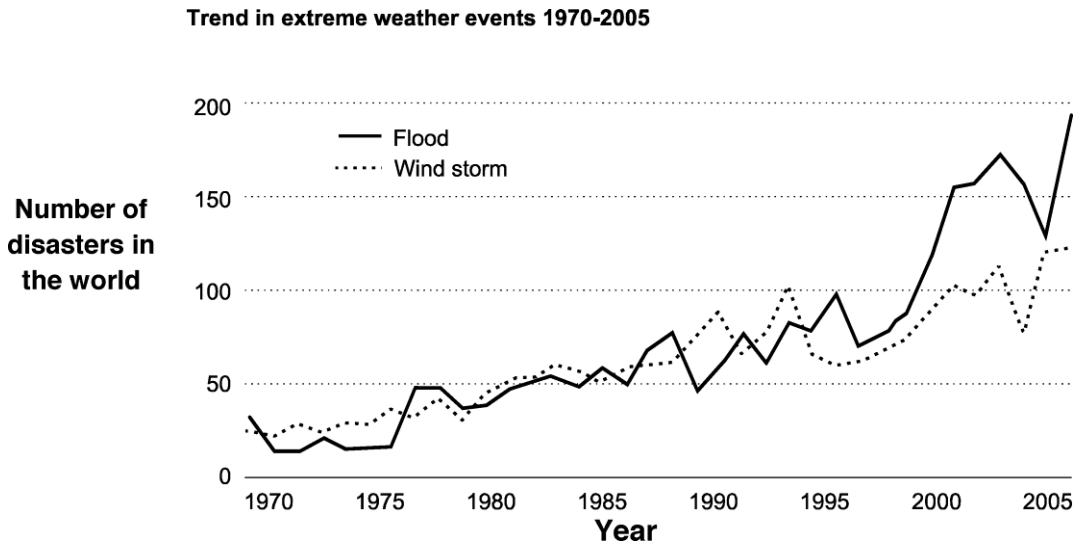


Fig. 1.1

Fossil fuels are burned for energy in power stations and for transport.

Fig. 1.2 shows how carbon emissions for the whole world have changed since 1800.

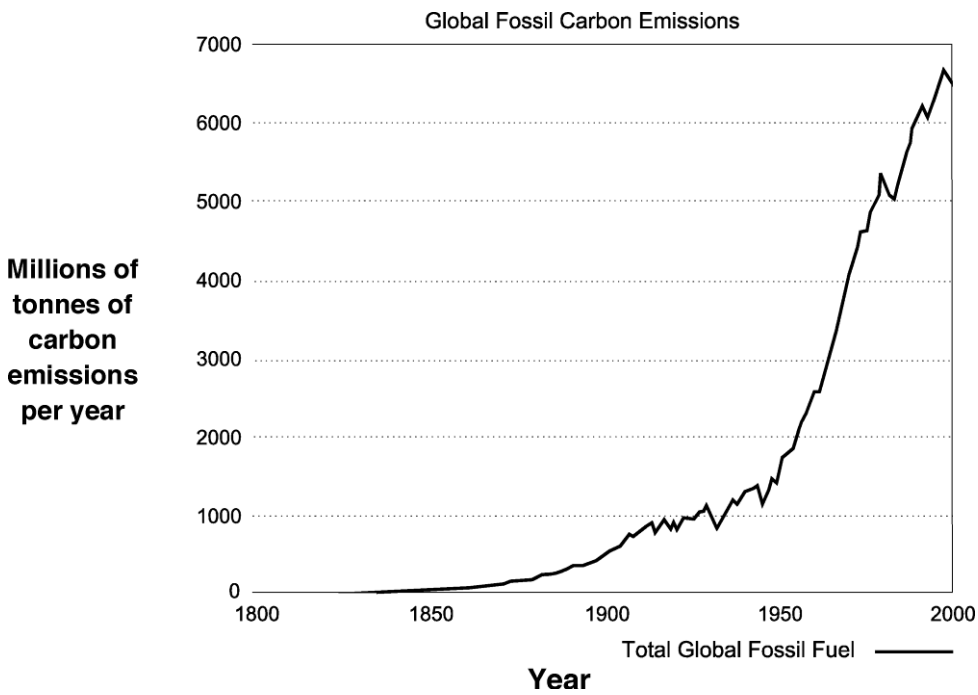


Fig. 1.2

Scientists believe that there is a correlation between the numbers of different types of extreme weather events and the levels of global carbon emissions from burning fossil fuels.

- (a) Describe the correlation between the number of floods and storms (**Fig. 1.1**) and global carbon emissions (**Fig. 1.2**).

Use data from the graphs in your answer.

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

- (b) **Fig. 1.1** shows data from 1970 onwards. It is very difficult to gather data about the numbers of floods and storms in the past.

Since 1970, the number of floods and storms has increased by more than 100%, although the rise in global temperature over the same time is relatively small.

- (i) Give reasons why it is difficult to gather reliable data about the number of floods and storms that have happened in the past.

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

- (ii) The table shows some data about the total number of floods and storms.

Period of time	1971–1980	2001–2010
Total number of floods and storms	750	3000

Use a calculation to show that the percentage increase in floods and storms between these two periods is 400%.

[2]

- (c) Floods and storms (**Fig. 1.2**) affect only some parts of the world and do **not** happen every day.

Scientists think that there is a correlation between carbon emissions (**Fig. 1.2**) and global temperatures (**Fig. 1.3**).

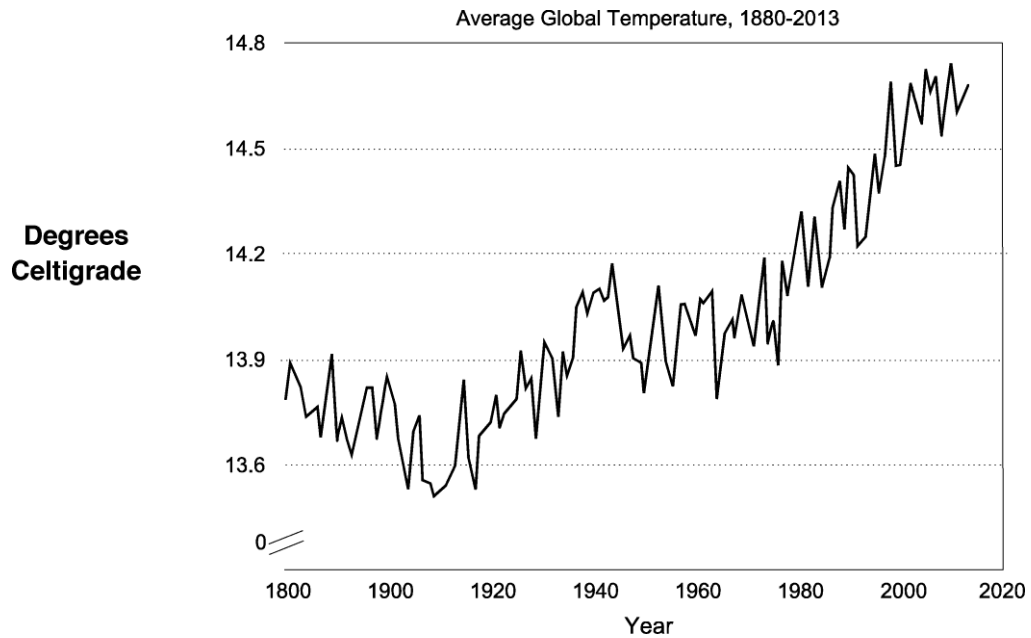
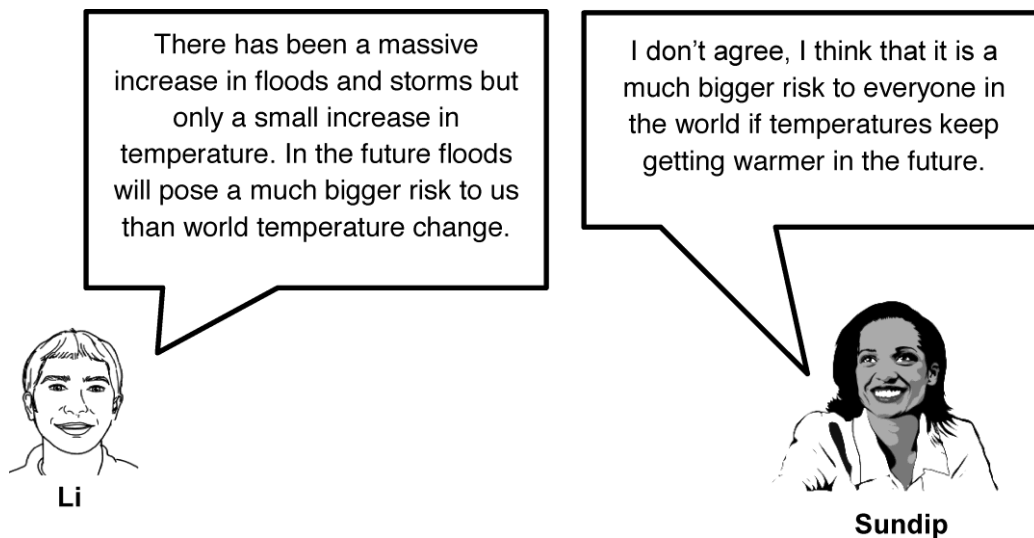


Fig 1.3

Li and Sundip talk about extreme weather and global temperature data.



Who do you think is right?

Explain your answer.

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..... [4]

(d) Read the information about a new way to reduce the problems caused by carbon emissions.



Carbon storage schemes ‘capture’ carbon emissions from power stations before they are released into the air. One method stores the gas permanently on a very large scale in oil wells. The gas helps to increase the pressure on the oil so that more oil can be extracted from the well.

Now, scientists in Poland have developed a new method of making a carbon storage material from old CDs.

Now that consumers download music and store it electronically, more and more CDs will be thrown away and can be recycled to make this new material. Scientists hope to be able to use the same methods to use other waste plastics.

Compare the benefits and drawbacks of using oil wells or old plastics for carbon emissions.

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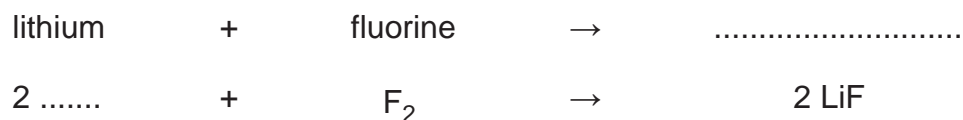
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..... [3]

2 Lithium is an element in Group 1 of the Periodic Table.

Lithium reacts with fluorine gas to form lithium fluoride.

(a) (i) Complete the word and symbol equation for the reaction.



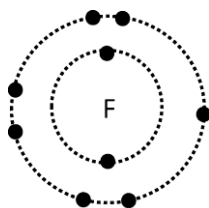
[2]

(ii) Draw lines to join each **substance** to its correct **description**.

Substance	Description
lithium	non-metal
fluorine	compound
lithium fluoride	metal

[2]

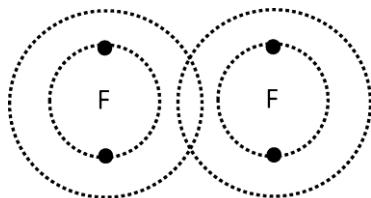
(b) (i) The diagram shows the arrangement of electrons in a fluorine atom.



fluorine atom

A fluorine molecule contains two atoms held together by a single covalent bond.

Complete the diagram to show the arrangement of electrons in a fluorine molecule.

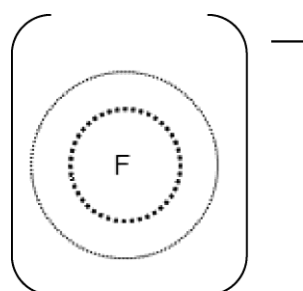


fluorine molecule

[2]

- (ii) In the reaction with lithium, each fluorine atom gains an electron to form a fluoride ion, F^- .

Complete the diagram to show the arrangement of electrons in a fluoride ion.



fluoride ion

[2]

- (c) The table shows some information about fluorine and lithium fluoride.

Substance	Structure	Melting point ($^{\circ}C$)
fluorine	simple covalent	-220
lithium fluoride	giant ionic	845

Why are the melting points of fluorine and lithium fluoride different?

Put ticks (✓) in the boxes next to the **two** correct answers.

Simple covalent substances have lower melting points than giant ionic substances.

Ions do **not** attract to each other.

There are weak forces between simple covalent molecules.

Ionic substances dissolve easily.

[2]

- 3 Sarah is a geologist. She takes samples of minerals from a range of rocks and tests them.

The table shows her results.

Mineral	Melting point	Electrical conductivity		
		when solid	when molten	when dissolved in water
A	high	good	good	does not dissolve in water
B	high	does not conduct	does not conduct	does not dissolve in water
C	high	does not conduct	good	good

- (a) How does the data show that all of the minerals are solids at room temperature?

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..... [1]

(b) Sarah thinks that the mineral samples contain a metal, an ionic compound and a covalent compound.

Explain the conclusions you can draw from Sarah's results about the bonding in the minerals.

(i) Mineral A

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..... [2]

(ii) Mineral B

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..... [2]

(iii) Mineral C

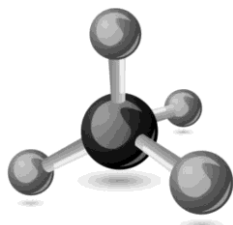
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- 4 The table shows information about some alkanes.

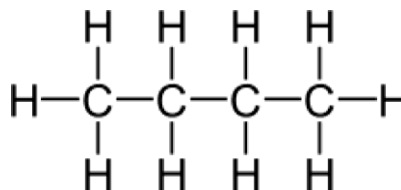
Name of alkane	Number of carbon atoms	Molecular formula
methane	1	CH ₄
ethane	2	C ₂ H ₆
propane	3	C ₃ H ₈
butane	4	C ₄ H ₁₀
pentane	5

- (a) Complete the table to show the molecular formula for pentane. [1]
- (b) The diagrams show a ball and stick model for one alkane and a displayed formula of another.

Complete the diagrams by filling in the missing names.



Name of alkane:



Name of alkane:

[2]

- (c) The alkanes have the general formula C_nH_(2n+2).

What is the molecular formula of an alkane with 8 carbon atoms?

..... [1]

- (d) Which statements about alkanes are true?

Put ticks (✓) in the boxes next to the **two** correct answers.

All alkanes are hydrocarbons.

Alkanes have double bonds between their carbon atoms.

The alkanes are a homologous series.

Alkanes are all solids at room temperature.

[2]

- 5 Alex works for a company that makes skateboards.



Customers complain that their skateboards lose performance when they get wet.

Skateboards have bearings in **each** wheel to help the wheels rotate smoothly and freely.



Skateboard wheel bearing

The bearings in the wheels contain smaller steel ball bearings.

These rust if they get wet.

The word equation for rusting is:

iron + water + oxygen → rust (hydrated iron(III)oxide)

- (a) Balance the symbol equation for the formation of rust.



[2]

(b) Alex thinks that the mass increase caused by the ball bearings rusting will be very small and will **not** affect the performance of the skateboard.

(i) Calculate the percentage by mass of iron in rust.

Give your answer to **2** decimal places.

- Relative formula mass of rust = 213.6

.....% [2]

(ii) Each bearing contains seven smaller ball bearings.

Calculate the increase in mass of the skateboard. if 2 g of the iron in each ball bearing turns to rust.

Give your answer to the nearest gram.

.....g [3]

(c) Sam thinks that the rust itself is the problem.

Suggest, with an explanation, how Alex could solve the problem of the rusting ball bearings.

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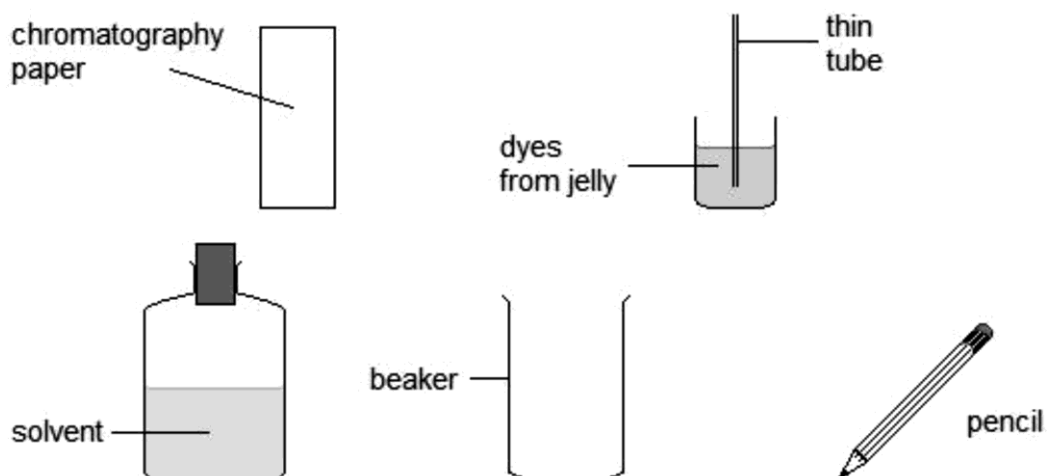
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..... [2]

- 6 Eve works in a laboratory where food dyes are tested.
Some dyes are banned because they are known to be harmful.
Eve is going to test a jelly that will be exported to the USA.

(a) Eve prepares a chromatogram of the jelly.

The diagrams show some apparatus she uses.



(i) 0.2% of the mass of the solvent is sodium chloride.

Calculate how much sodium chloride she needs to use to make 250 cm^3 of the solvent.

Assume 1 cm^3 of solvent has a mass of 1 g.

amount of sodium chloride =g [2]

(ii) Describe how Eve should set up her chromatogram of the jelly.

You may use a diagram in your answer.

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7 Fertilisers are used to help to grow food.

The first stage of making fertilisers uses hydrogen to make ammonia.

Very large amounts of hydrogen are needed.

The table shows some information about one large scale process for making hydrogen.

Raw materials	<ul style="list-style-type: none"> • methane gas from refining crude oil • steam
Temperature of process (°C)	700 – 1100
Waste gases	<ul style="list-style-type: none"> • carbon dioxide, • carbon monoxide, • unreacted methane
Atom economy (%)	< 20

(a) The waste gases are collected to make sure that they do not harm the workers.

Which waste gas is directly harmful to people? What are its effects?

Gas:

Effect on people:

..... [2]

(b) Jack thinks that this process is **not** sustainable in the long term.

Explain why Jack thinks this.

Use the information in the table to help you to explain your reasoning.

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..... [3]

(c) The equation for the process is:

methane + steam \rightleftharpoons hydrogen + carbon dioxide



In this reaction, the methane is never used up there is always some left over.

(i) How does the equation show that the methane can never be all used up?

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..... [2]

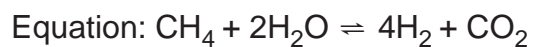
(ii) The leftover methane is recycled back into the start of the process.

Explain why this makes the process more sustainable.

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..... [2]

- (d) (i) Jack uses this equation to calculate the atom economy of the process.

$$\text{Atom economy} = \frac{\text{Total mass of hydrogen molecules made} \times 100\%}{\text{Total mass of molecules used}}$$



Calculate the atom economy for this process.

atom economy =% [3]

- (ii) The information says that the atom economy is < 20 %.

Does the value you have calculated agree with this?

Explain your reasoning.

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..... [2]

- 9 Mendeleev organised the elements into the first Periodic Table.

The diagram shows some elements from Groups 2 and 3 in Mendeleev's Periodic Table.

Group 2	Group 3
Be	B
Mg	Al
Cd	(gap)
Zn	(gap)

- (a) Mendeleev left gaps in his table.

Two gaps are shown in Group 3.

Explain why these gaps were so important.

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- (b) Two of the elements in Mendeleev's Group 2 are **not** in Group 2 of the modern Periodic Table.

Identify the elements and state where they are found in the modern Periodic Table.

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..... [2]

END OF QUESTION PAPER