

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

B742/01

GATEWAY SCIENCE
CHEMISTRY B

Chemistry modules C4 C5 C6
(Foundation Tier)

THURSDAY 13 JUNE 2013: Morning

DURATION: 1 hour 30 minutes
plus your additional time allowance

MODIFIED ENLARGED

| | | | |
|-------------------------------|--|------------------------------|--|
| Candidate forename | | Candidate surname | |
|-------------------------------|--|------------------------------|--|

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

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:


Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. HB pencil may be used for graphs and diagrams only.**
- **Answer ALL the questions.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

INFORMATION FOR CANDIDATES

- **Your quality of written communication is assessed in questions marked with a pencil ().**
- **The Periodic Table can be found on the back page.**
- **The number of marks is given in brackets [] at the end of each question or part question.**
- **The total number of marks for this paper is 85.**
- **Any blank pages are indicated.**

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Answer ALL the questions.

SECTION A – MODULE C4

- 1 The table shows the electronic structures of the atoms of some elements.**

| Element | Symbol | Electronic structure |
|----------------|---------------|-----------------------------|
| helium | He | 2 |
| oxygen | O | 2.6 |
| neon | Ne | 2.8 |
| magnesium | Mg | 2.8.2 |
| chlorine | Cl | 2.8.7 |
| calcium | Ca | 2.8.8.2 |

- (a) How many ELECTRONS are there in one atom of chlorine?**

_____ [1]

- (b) What is the ATOMIC NUMBER of magnesium?**

_____ [1]

- (c) Write down the symbols for two elements in the same GROUP of the periodic table.**

Choose from the table above.

_____ and _____ [1]

(d) Write down the symbols for two elements in the same PERIOD of the periodic table.

Choose from the table above.

_____ and _____ **[1]**

[TOTAL: 4]

- 2 In 1808, a scientist named Dalton published his atomic theory.**

Dalton thought that:

elements were made up of atoms

atoms could NOT be split into simpler particles.

About a century later, a scientist called Rutherford published another atomic theory.

Rutherford thought that:

atoms had a positively charged nucleus

electrons orbited the nucleus.

- (a) Why is it important that scientists publish their theories?**

[2]

- (b) Write about one DIFFERENCE between Dalton's atomic theory and Rutherford's atomic theory.**

[1]

(c) What is the electrical charge on an electron?

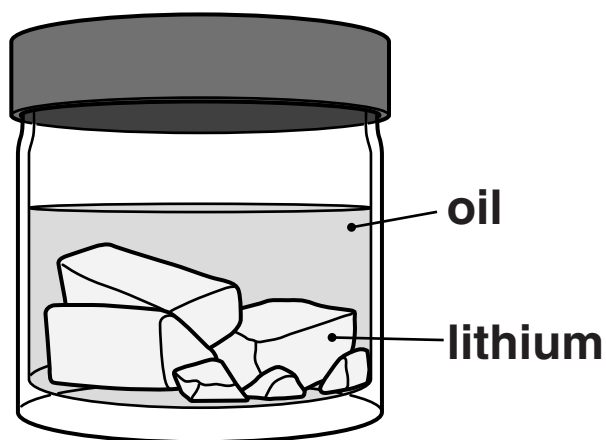
_____ **[1]**

[TOTAL: 4]

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3 Lithium, Li, is in Group 1 of the Periodic Table.

(a) Lithium is stored under oil in a sealed bottle.



Explain why lithium is stored under oil.

[2]

(b) Laura's teacher adds a small piece of lithium to a bowl of water.



The lithium reacts with the water.

The lithium moves about on the surface of the water.

Laura sees bubbles of hydrogen being made.

The piece of lithium gets smaller and smaller until it has completely reacted.

A solution of lithium hydroxide is made.

Caesium, **CS, is another element in Group 1.**

Predict, including a word equation, how the reaction of CAESIUM with water compares with the reaction of LITHIUM with water.



**The quality of written communication
will be assessed in your answer to this
question.**

[6]

[TOTAL: 8]

- 4 Oskar investigates the thermal decomposition of zinc carbonate.

zinc carbonate \longrightarrow zinc oxide + carbon dioxide

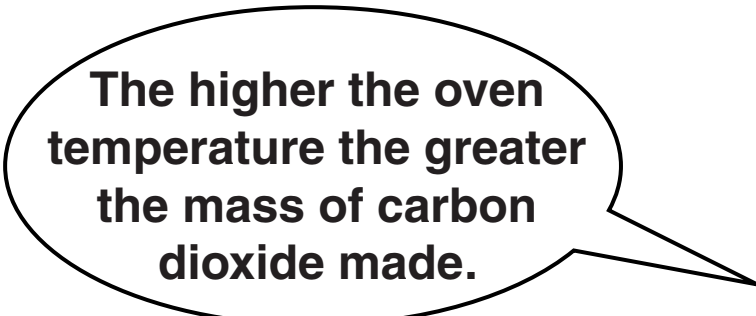
He heats 4.0 g of solid zinc carbonate for 30 minutes in a hot oven.

He lets the solid cool down and then measures its mass.

He repeats the experiment four more times.

Each time he uses a different oven temperature.

Oskar makes a prediction.



The higher the oven temperature the greater the mass of carbon dioxide made.

Look at Oskar's results.

| Oven temperature in °C | 200 | 300 | 400 | 500 | 600 |
|--------------------------------------|------|------|------|------|------|
| Mass of zinc carbonate at start in g | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Mass of solid after heating in g | 4.00 | 3.42 | 2.65 | 2.59 | 2.59 |

(a) Do Oskar's results support his prediction?

Explain your answer.

[2]

(b) Oskar wants to check that carbon dioxide is made during the reaction.

What is the chemical test for carbon dioxide?

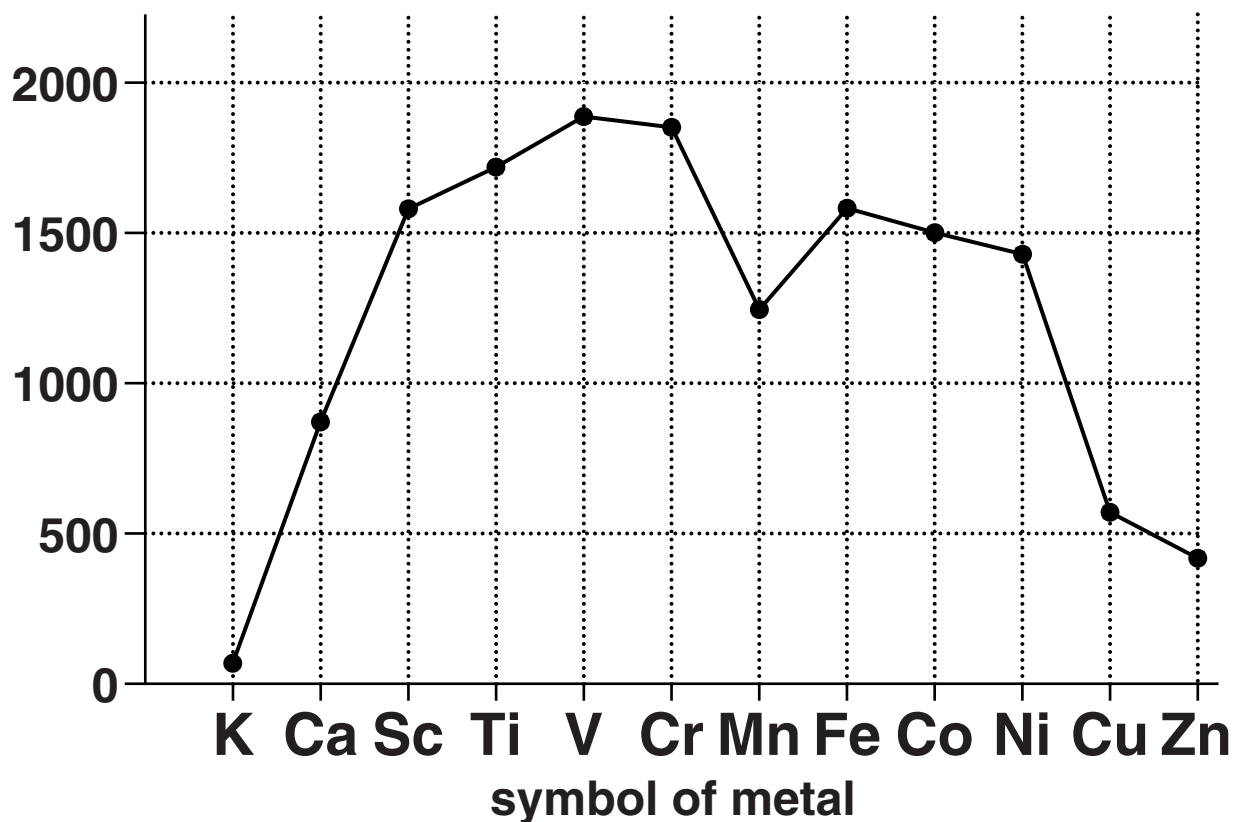
[2]

[TOTAL: 4]

5 Most metals have high melting points.

Look at the graph. It shows the melting points of some metals.

melting point in °C



(a) Write the SYMBOL of a metal that can be used to make a container to melt iron.

Explain your answer.

[2]

(b) Write the SYMBOL of the metal which has the WEAKEST metallic bonds.

_____ **[1]**

(c) One property of metals is that they often have high melting points.

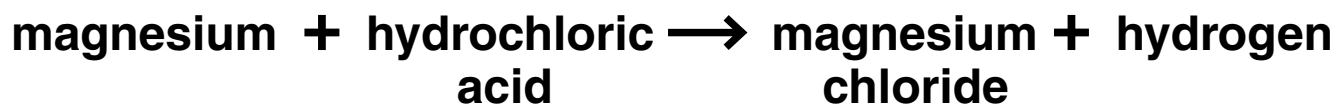
Write about OTHER properties of metals.

_____ **[2]**

[TOTAL: 5]

SECTION B – MODULE C5

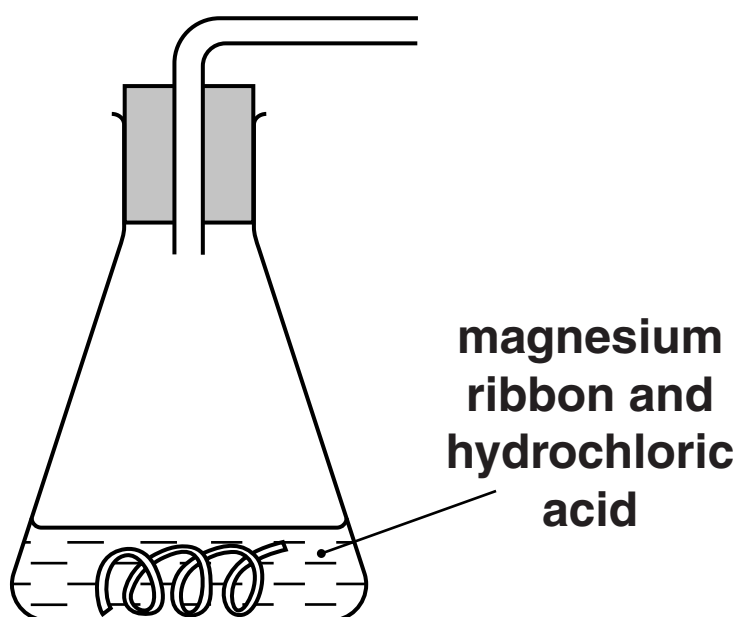
- 6 Trevor and Julie investigate the reaction between magnesium and hydrochloric acid at 20°C .



- (a) Hydrogen gas is given off in the reaction.

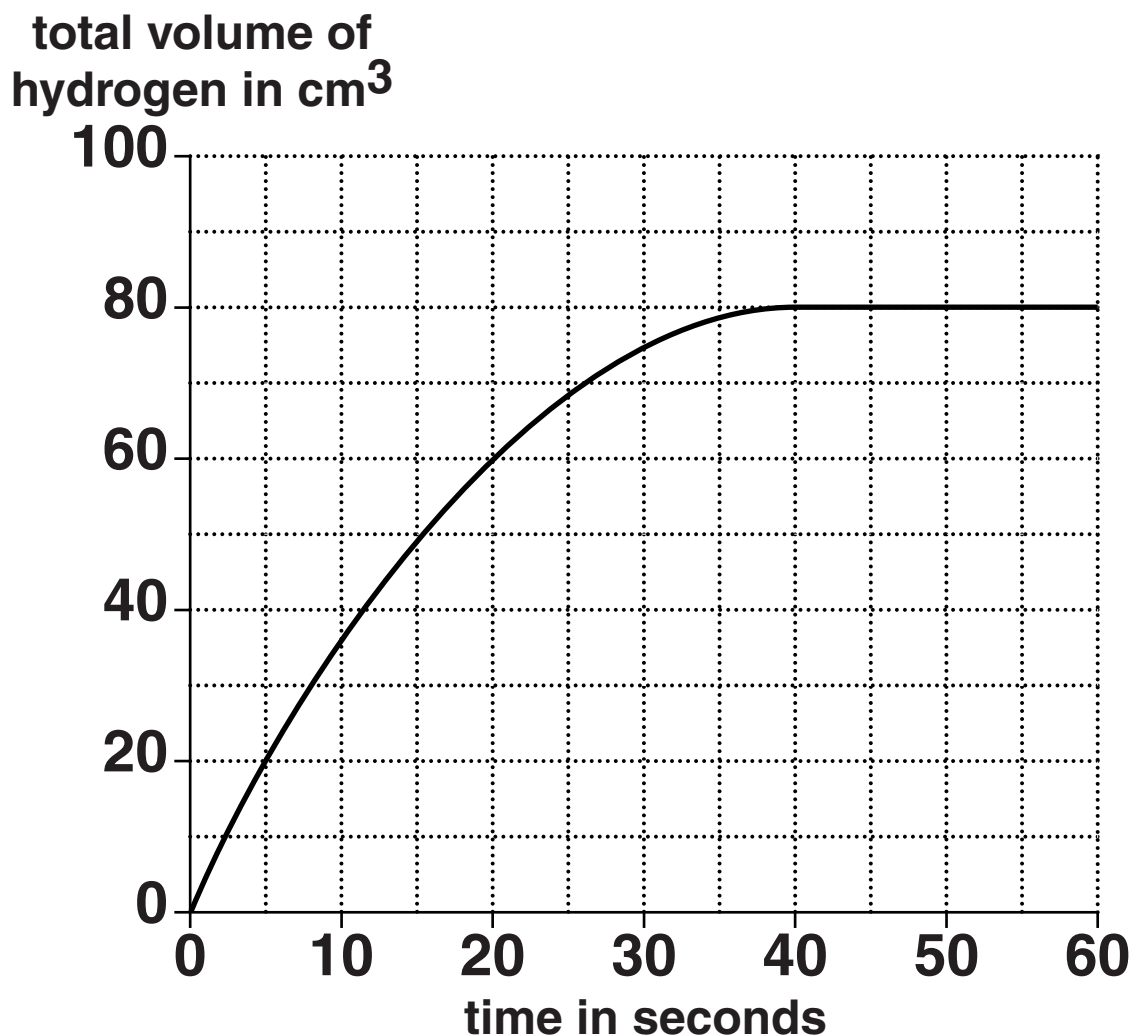
Look at the diagram. It shows PART of the apparatus they use.

Complete the diagram to show how Trevor and Julie can COLLECT and MEASURE the volume of hydrogen made.



[2]

(b) Look at the graph. It shows their results.



(i) How long does it take for the reaction to stop?

answer _____ seconds [1]

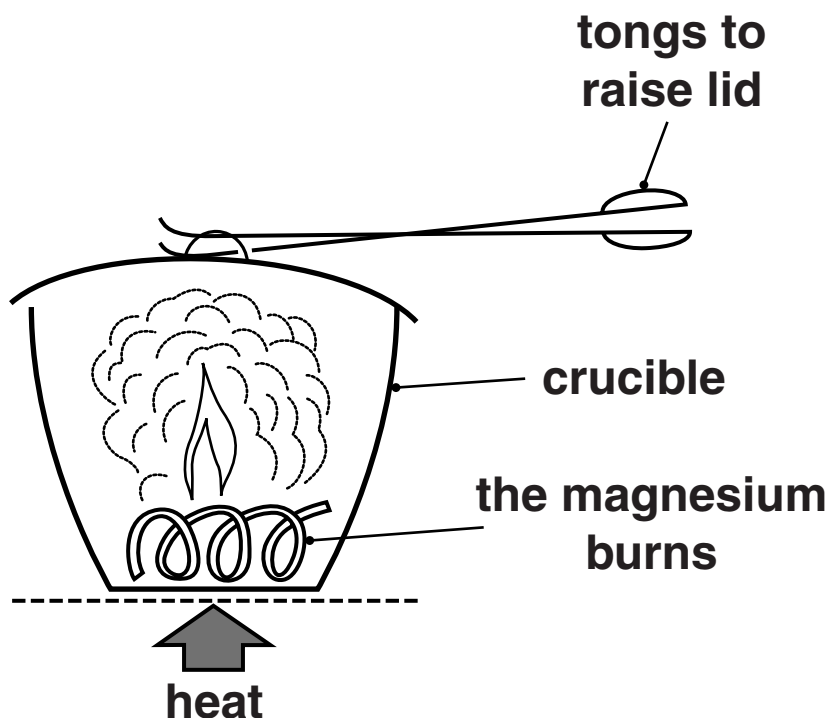
(ii) Why does the reaction stop?

_____ [1]

[TOTAL: 4]

7 Nick reacts magnesium with oxygen.

He heats the magnesium in a crucible.



The magnesium reacts with oxygen in the air.

Magnesium oxide is made.

magnesium + oxygen \longrightarrow magnesium oxide

Nick does the experiment four times with different masses of magnesium.

Look at the table of his results.

| Mass of magnesium in g | Mass of oxygen used in g | Mass of magnesium oxide made in g |
|---------------------------|--------------------------------|---|
| 0.10 | 0.07 | 0.17 |
| 0.20 | 0.14 | 0.34 |
| 0.30 | 0.21 | _____ |
| 0.40 | _____ | 0.68 |

(a) Complete the table. [2]

(b) How much magnesium would Nick need to make 1.7 g of magnesium oxide?

Explain how you worked out your answer.

_____ [2]

(c) Calculate the molar mass of magnesium oxide, MgO.

The relative atomic mass of Mg is 24 and of O is 16.

answer _____ g/mol [1]

[TOTAL: 5]

8 This question is about acid-base titrations.

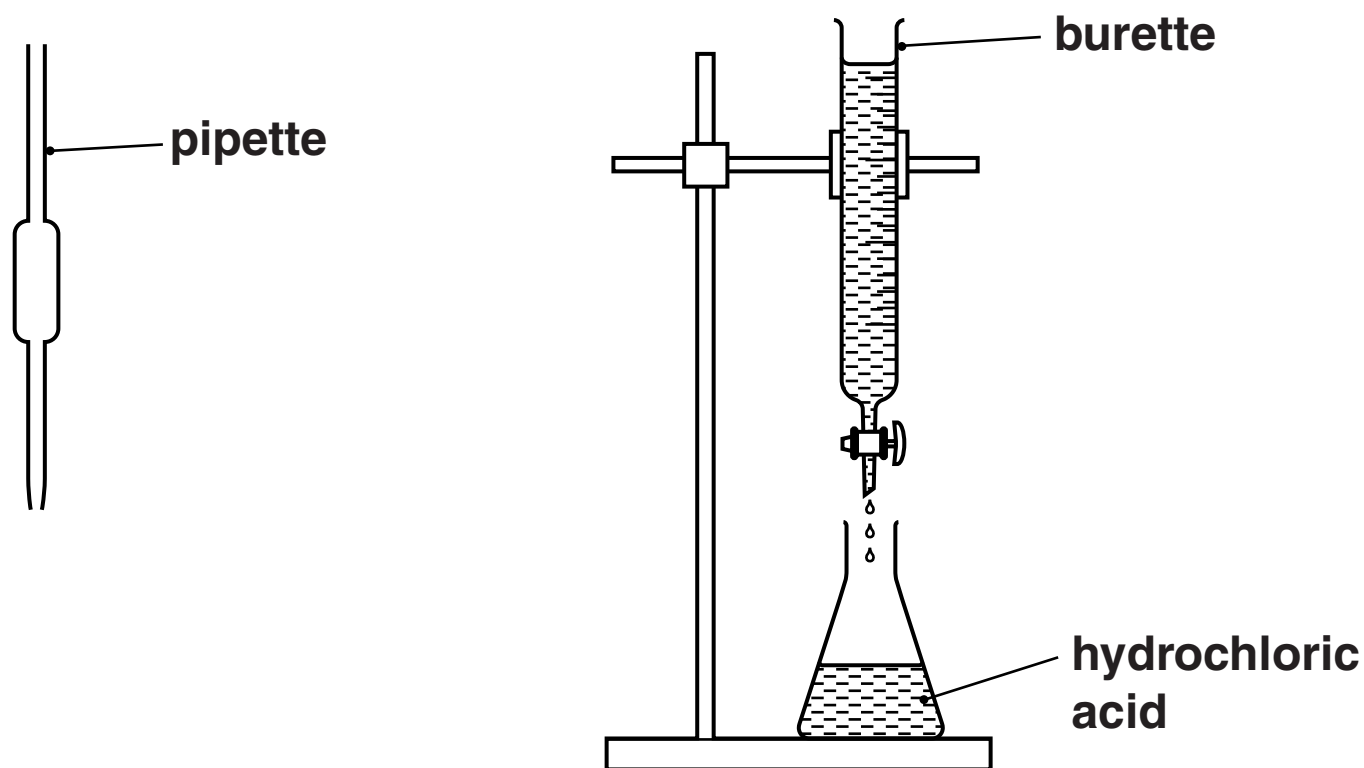
(a) Complete the table to show the colours of acid-base indicators.

| Indicator | Colour in | |
|------------------------|-------------------|---------------|
| | Acid | Alkali |
| litmus | red | blue |
| phenolphthalein | colourless | _____ |

[1]

(b) Brian neutralises dilute hydrochloric acid with sodium hydroxide solution.

Look at the apparatus he uses to do a titration.



He uses the pipette to measure 25.0 cm^3 of hydrochloric acid into the flask.

Describe how Brian completes the titration.

[3]

(c) Brian does three more titrations.

Look at his results.

| Titration number | 1 | 2 | 3 | 4 |
|---|-------------|-------------|-------------|-------------|
| Volume of sodium hydroxide added in cm³ | 22.9 | 22.1 | 22.3 | 22.2 |

- (i) Calculate the mean (average) volume of sodium hydroxide solution added for titrations 2, 3 and 4.**

mean volume of sodium hydroxide solution

added = _____ cm³ [1]

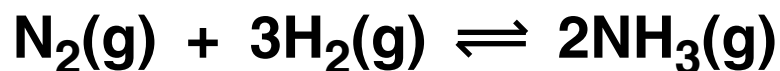
- (ii) Titration 1 was not included in the calculation of the mean volume of sodium hydroxide added.**

Suggest why.

_____ [1]

[TOTAL: 6]

- 9 Ammonia is made from nitrogen and hydrogen in a **REVERSIBLE** reaction, which reaches an **EQUILIBRIUM**.



Look at **TABLE 1**.

It shows the percentage of ammonia in the equilibrium mixture at **450 °C** and different **PRESSURES**.

TABLE 1

| Pressure in atmospheres | Percentage (%) of ammonia at 450 °C |
|------------------------------------|--|
| 1 | 0.2 |
| 50 | 9.5 |
| 100 | 16.2 |
| 200 | 25.3 |

Look at TABLE 2.

It shows the percentage of ammonia in the equilibrium mixture at 300 atmospheres and different TEMPERATURES.

TABLE 2

| Temperature in °C | Percentage (%) of ammonia at 300 atmospheres |
|------------------------------|---|
| 400 | 50 |
| 450 | 35 |
| 500 | 25 |
| 550 | 17 |

The reaction between nitrogen and hydrogen is a REVERSIBLE reaction which reaches an EQUILIBRIUM.

What is meant by a reversible reaction which reaches an equilibrium?

How does changing the pressure and temperature affect the position of equilibrium?



The quality of written communication will be assessed in your answer to this question.

[6]

[TOTAL: 6]

10 Look at the table.

It shows information about the contents of some foods on food labels.

It also shows the Guideline Daily Amounts (GDA) for an adult.

| Food contents | Small pizza | Chicken curry | Fish in cheese sauce | GDA for an adult |
|---------------------------|--------------------|----------------------|-----------------------------|-------------------------|
| Energy in calories | 396 | 384 | 200 | 2000 |
| Protein in g | 16.9 | 41.4 | 22.8 | 45 |
| Carbohydrate in g | 51.3 | 11.0 | 2.9 | 230 |
| Fat in g | 13.7 | 19.2 | 10.8 | 70 |
| Sodium in g | 0.7 | 0.9 | 0.4 | 2.3 |

(a) Look at the information for the chicken curry.

What percentage of the GDA for FAT is in the chicken curry?

answer _____ %

[2]

(b) A scientist writes a summary about the contents of food.

THE CONTENTS OF FOOD

- 1 Too much energy content causes obesity.**
- 2 Proteins are needed for growth and repair.**
- 3 Carbohydrates provide energy but eating too much causes obesity.**
- 4 Fats can be stored as body fat and can cause heart disease.**
- 5 Too much sodium can cause heart disease.**

Using this summary, together with the information in the table about food contents, which of the three foods in the table is the most healthy?

Explain your answer.

[2]

[TOTAL: 4]

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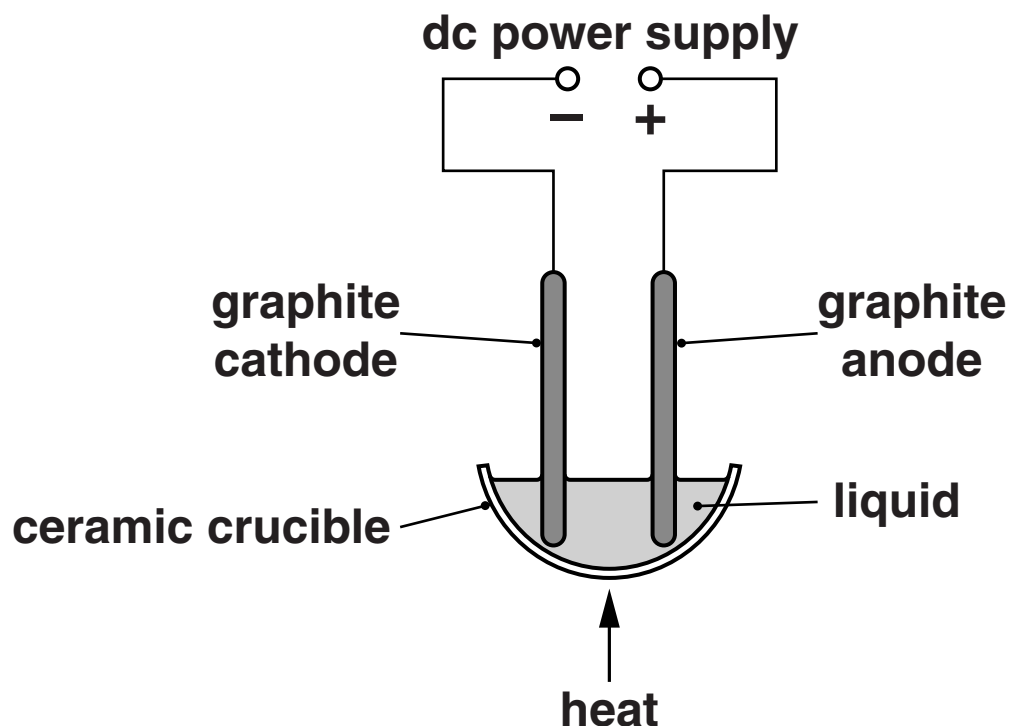
SECTION C BEGINS ON PAGE 30

SECTION C – MODULE C6

- 11 (a) Joel's teacher investigates the electrolysis of four liquids.

The first liquid he uses is melted sodium chloride.

Look at the apparatus he uses.



The table shows the products made.

| Liquid | Product at cathode | Product at anode |
|------------------|--------------------|------------------|
| lead bromide | lead | bromine |
| lead iodide | lead | iodine |
| sodium chloride | sodium | _____ |
| potassium iodide | _____ | iodine |

(i) Complete the table. [2]

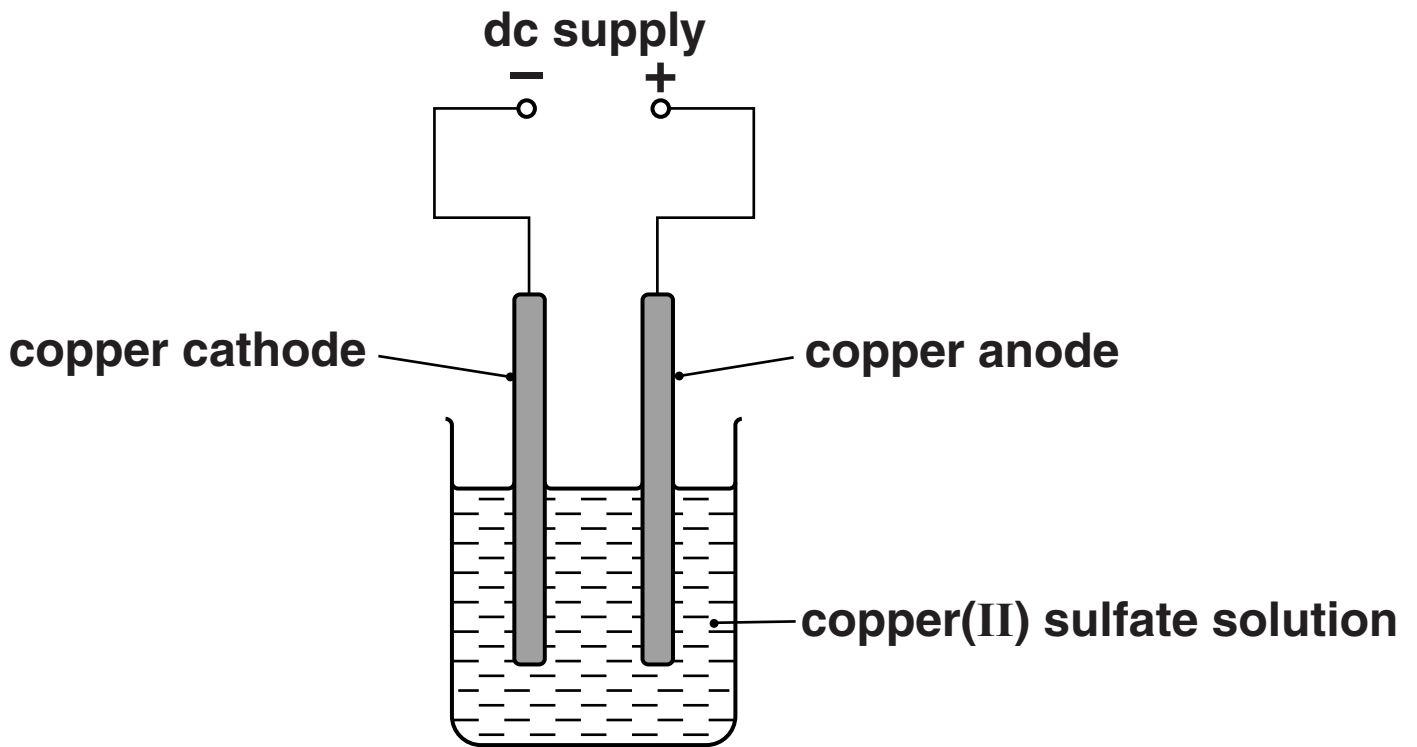
(ii) Sodium chloride contains sodium ions, Na^+ , and chloride ions, Cl^- .

SOLID sodium chloride does NOT conduct electricity, but MELTED sodium chloride DOES conduct electricity.

Explain why.

_____ [2]

**(b) Joel passes an electric current through
COPPER(II) SULFATE SOLUTION.**



Joel does four experiments.

Joel changes either the TIME or the CURRENT.

Copper is made at the cathode.

He measures how much copper is made in each experiment.

| Experiment | Current in amps | Time in minutes | Mass of copper made in g |
|------------|-----------------|-----------------|--------------------------|
| 1 | 0.15 | 5 | 0.20 |
| 2 | 0.30 | 5 | 0.40 |
| 3 | 0.15 | 10 | 0.40 |
| 4 | 0.60 | 10 | 1.60 |

Joel concludes that the amount of copper made is **PROPORTIONAL** to both the current and to the time.

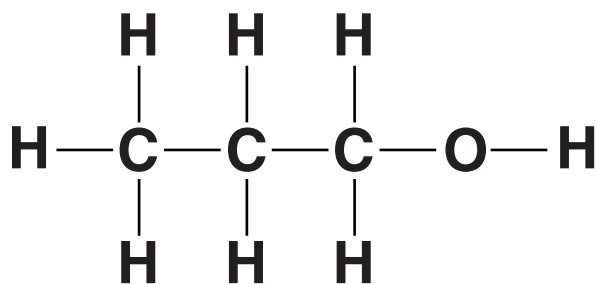
Show how the results support this conclusion.

[2]

[TOTAL: 6]

12 Propanol and ethanol are alcohols.

(a) Look at the displayed formula of propanol.



Propanol is NOT a hydrocarbon.

Explain why.

[1]

(b) Ethanol can be made from ethene.

Look at the word equation.

ethene + water \longrightarrow ethanol

Write down the name of this type of reaction.

Choose from the list.

displacement

electrolysis

hydration

galvanising

answer _____ [1]

- (c) Ethanol can also be made by fermentation from glucose.**

Write about how fermentation can be used to make ethanol. Include the conditions needed for fermentation and how to get PURE ethanol from the reaction mixture.



The quality of written communication will be assessed in your answer to this question.

[6]

[TOTAL: 8]

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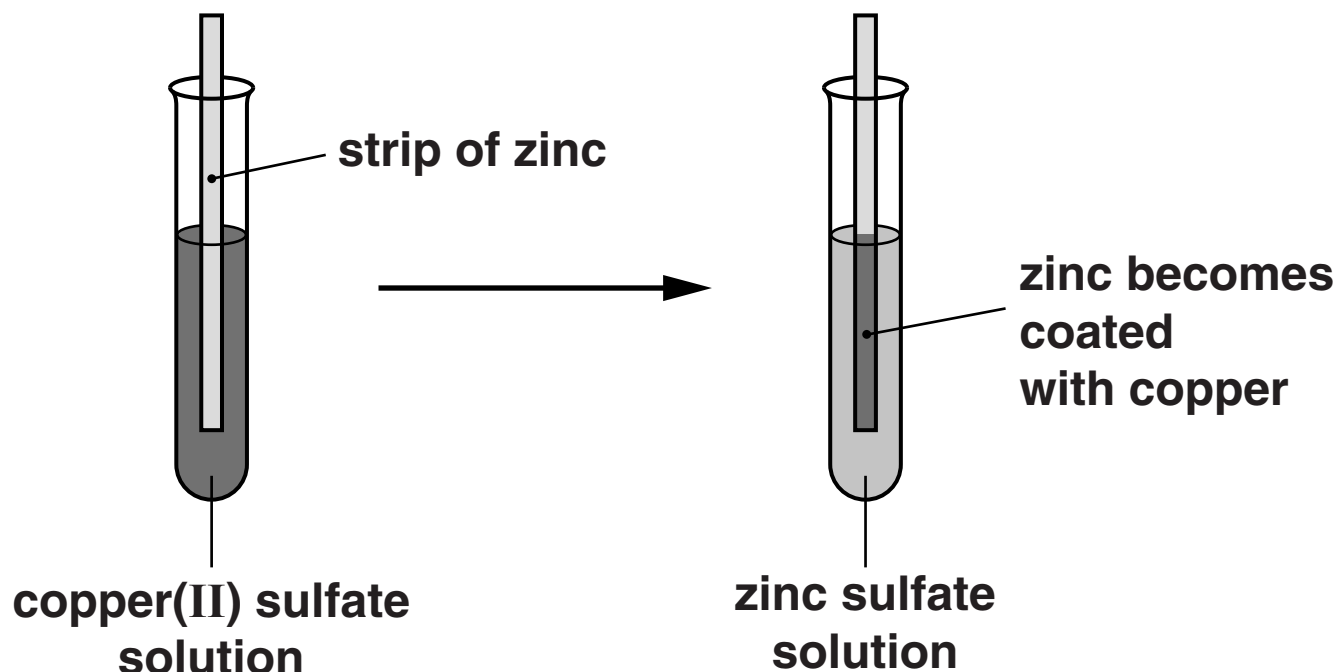
QUESTION 13 BEGINS ON PAGE 38

13 Jill investigates the reactivity of some metals.

Look at the diagram. It shows what happens when she puts a strip of zinc into copper(II) sulfate solution.

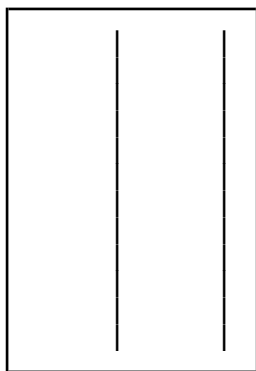
start of experiment

end of experiment

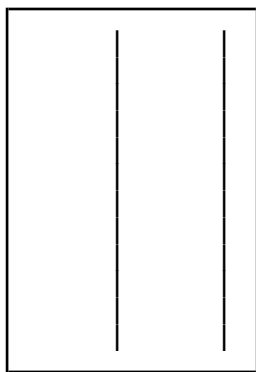
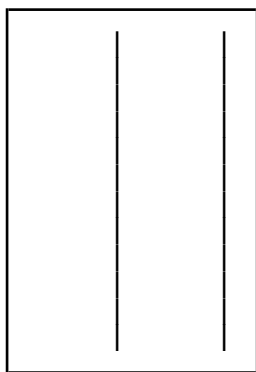


(a) Write the WORD equation (opposite) for the reaction between zinc and copper(II) sulfate solution.

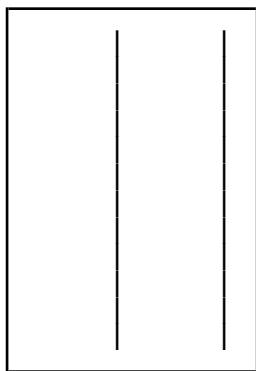
[1]



+



+



(b) Jill repeats the experiment with other metals and solutions.

Look at her table of results.

Key: \times = no reaction

\checkmark = metal reacts

| Solution used | Metal being added | | | |
|--------------------|-------------------|----------|--------------|--------------|
| | Iron | Copper | Magnesium | Zinc |
| Iron(II) sulfate | | \times | \checkmark | \checkmark |
| Copper(II) sulfate | \checkmark | | \checkmark | \checkmark |
| Magnesium sulfate | \times | \times | | \times |
| Zinc sulfate | \times | \times | \checkmark | |

Write down the **FOUR** metals, copper, iron, magnesium and zinc, in order of reactivity.

Use the table of results to help you. The first metal has been completed for you.

MOST reactive metal

magnesium

LEAST reactive metal

[1]

(c) Jill finds out that copper reacts with silver nitrate solution.

Predict what will happen if Jill puts a strip of COPPER into a solution of SILVER NITRATE.

Explain your answer.

[2]

[TOTAL: 4]

14 This question is about hard and soft water.

- (a) Jean investigates which ions cause hardness in water.

She has four different water samples, A, B, C and D.

She shakes 10 cm^3 of each water sample with 0.5 cm^3 of soap solution.

| Water sample | Ions present in water sample | Reaction with soap solution |
|--------------|--------------------------------------|-----------------------------|
| A | Na^+ and Cl^- | no scum, lots of lather |
| B | Ca^{2+} and Cl^- | lots of scum, no lather |
| C | K^+ and NO_3^- | no scum, lots of lather |
| D | Mg^{2+} and NO_3^- | some scum, little lather |

- (i) Which sample of water is the HARDEST?

Choose from A, B, C or D.

_____ [1]

- (ii) The results show that Cl^- does NOT cause water to be hard.

Explain why.

_____ [1]

(b) Jean investigates different types of water softeners.

Write about different ways hard water can be softened.

[2]

[TOTAL: 4]

15 Chlorofluorocarbons, CFCs, were used in the 1970s.

Scientists found evidence that CFCs cause holes in the ozone layer.

This allows more ultraviolet light to reach the surface of the Earth.

- (a) Describe some of the medical problems caused by the increasing levels of ultraviolet light.**

[2]

- (b) The use of chlorofluorocarbons such as CCl_3F has now been banned in the UK.**

Hydrofluorocarbons such as C_2HF_5 are now being used instead.

Explain which formula, CCl_3F or C_2HF_5 , contains the MOST atoms.

[1]

[TOTAL: 3]

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SECTION D BEGINS ON PAGE 46

SECTION D

- 16 Scientists are concerned about the pollution of both the air and water.

Chlorofluorocarbons, **CFCs**, are pollutants found in the air.

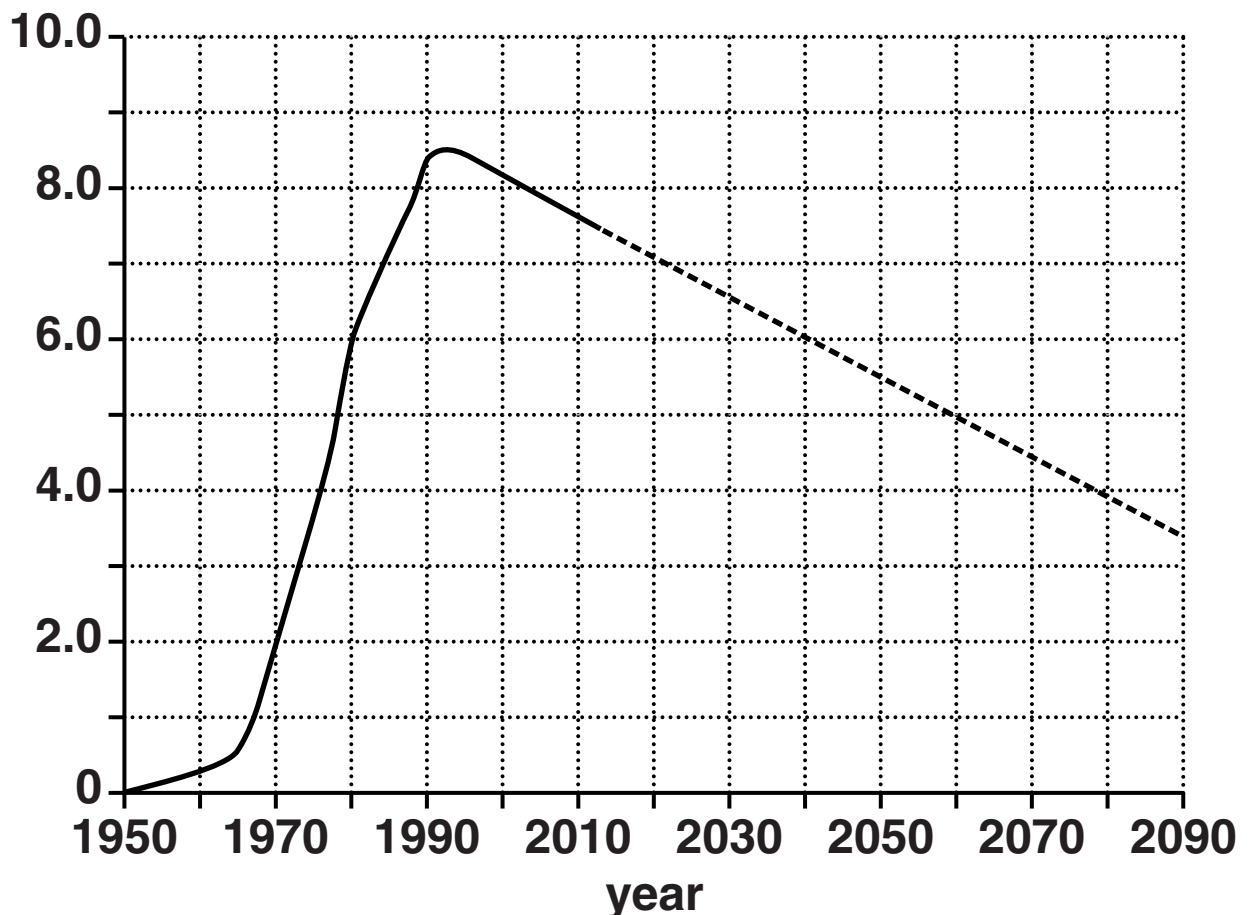
CFC11 is a chlorofluorocarbon.

Look at the graph.

It shows how the concentration of **CFC11** in the air has changed between 1950 and 2013.

The dotted line shows how it may change up to 2090.

relative concentration of
CFC11 in the air



(a) Describe how the concentration of CFC11 has changed from 1950 until 2013.

[2]

(b) Many countries signed an international agreement to ban the use of CFCs.

Use the graph to suggest in which year the ban first started.

Explain your answer.

[2]

(c) CFC11 dissolves in rainwater.

Some rainwater collects underground.

Once underground, the concentration of CFC11 in the water does not change.

In 2013, a scientist analyses some underground rainwater.

She finds that the CFC11 concentration in the air, when the rain fell, was 2.0 units.

Use the graph to decide how many years this rainwater has been underground.

[2]

(d) Look at the graph.

Estimate the year when the concentration of CFC11 will drop to 50% of the 2003 value.

[2]

(e) **CFC12** is another chlorofluorocarbon.

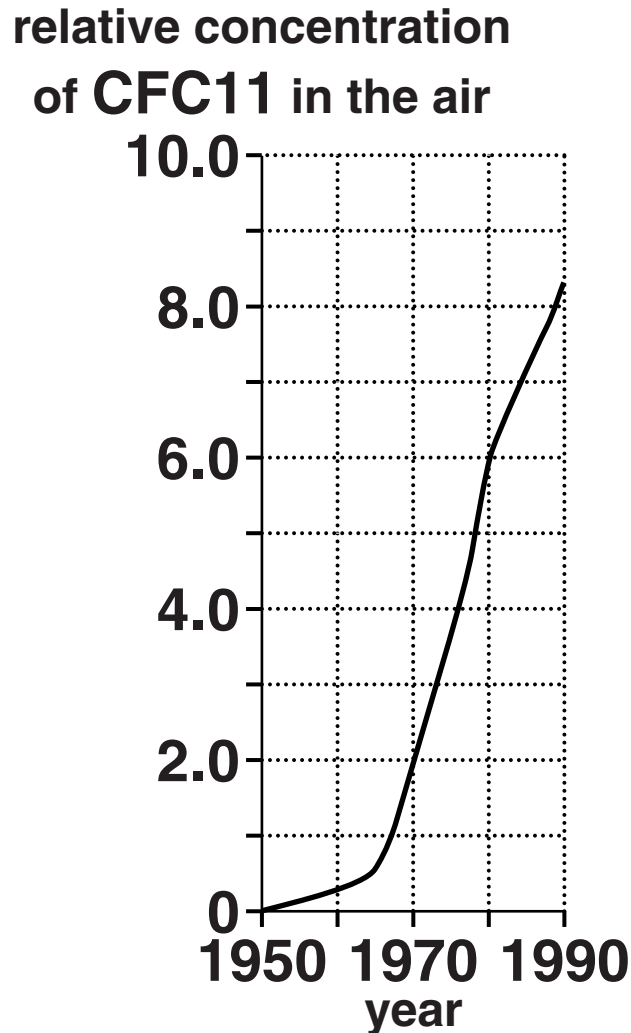
Look at the table.

It shows how the concentration of **CFC12** in the air has changed between **1950** and **1990**.

| Year | Relative concentration of CFC12 in the air |
|-------------|--|
| 1950 | 0 |
| 1960 | 0.1 |
| 1970 | 1.2 |
| 1980 | 4.0 |
| 1990 | 4.3 |

Look at this graph.

It shows how the concentration of **CFC11** in the air has changed between **1950** and **1990**.



How does the concentration of **CFC12** compare with that of **CFC11**?

[1]

- (f) Scientists think that **CFCs** cause ozone depletion.

Look at the graph.

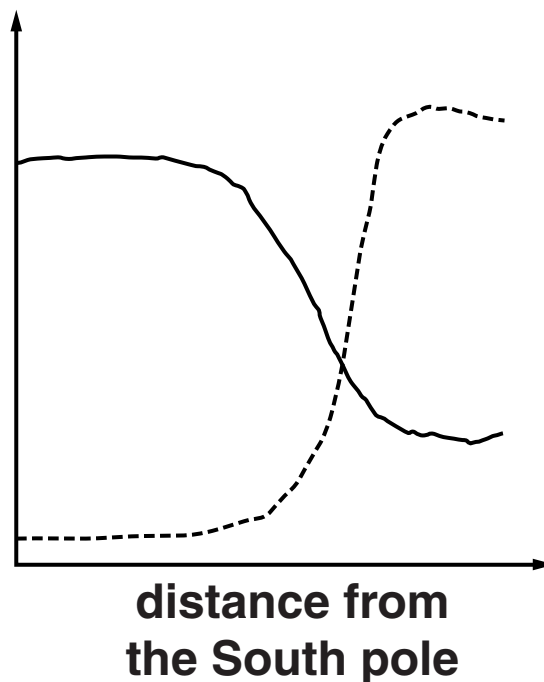
It shows how the ozone concentration and **CFCs** concentration change with increasing distance from the South Pole.

KEY:

----- ozone

—— CFCs

relative concentration
of gases



How does the information in the graph support the idea that **CFCs** cause ozone depletion?

[1]

[TOTAL: 10]

END OF QUESTION PAPER

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The Periodic Table of the Elements

| | | | | | | | |
|---|--|--|------------------------------------|------------------------------------|-------------------------------------|--------------------------------------|-----------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 |
| 7 Li lithium 3 | 9 Be beryllium 4 | <div>Key</div> <div>relative atomic mass atomic symbol name atomic (proton) number</div> | | | | | 4 He helium 2 |
| 23 Na sodium 11 | 24 Mg magnesium 12 | <div>1 H hydrogen 1</div> | | | | | 19 F fluorine 9 |
| 39 K potassium 19 | 40 Ca calcium 20 | 11 B boron 5 | 12 C carbon 6 | 14 N nitrogen 7 | 16 O oxygen 8 | 17 Cl chlorine 17 | 20 Ne neon 10 |
| 85 Rb rubidium 37 | 88 Sr strontium 38 | 27 Al aluminium 13 | 28 Si silicon 14 | 31 P phosphorus 15 | 32 S sulfur 16 | 35.5 Cl chlorine 17 | 40 Ar argon 18 |
| 133 Cs caesium 55 | 137 Ba barium 56 | 70 Ga gallium 31 | 73 Ge germanium 32 | 75 As arsenic 33 | 79 Se selenium 34 | 80 Br bromine 35 | 84 Kr krypton 36 |
| [223] Fr francium 87 | [226] Ra radium 88 | 115 In indium 49 | 119 Sn tin 50 | 122 Sb antimony 51 | 128 Te tellurium 52 | 127 I iodine 53 | 131 Xe xenon 54 |
| [227] Ac* actinium 89 | [227] La* lanthanum 57 | 112 Cd cadmium 48 | 201 Hg mercury 80 | 209 Pb lead 82 | 207 Pb lead 82 | [210] At astatine 85 | [222] Rn radon 86 |
| Elements with atomic numbers 112-116 have been reported but not fully authenticated | | | | | | | |
| [272] Rg roentgenium 111 | | | | | | | |
| [271] Ds darmstadtium 110 | | | | | | | |
| [268] Mt meitnerium 109 | | | | | | | |
| [277] Hs hassium 108 | | | | | | | |
| [264] Bh bohrium 107 | | | | | | | |
| [266] Sg seaborgium 106 | | | | | | | |
| [262] Db dubnium 105 | | | | | | | |
| [261] Rf rutherfordium 104 | | | | | | | |
| [227] La* lanthanum 57 | | | | | | | |
| 178 Hf hafnium 72 | | | | | | | |
| 181 Ta tantalum 73 | | | | | | | |
| 184 W tungsten 74 | | | | | | | |
| 186 Re rhenium 75 | | | | | | | |
| 190 Os osmium 76 | | | | | | | |
| 192 Ir iridium 77 | | | | | | | |
| 195 Pt platinum 78 | | | | | | | |
| 197 Au gold 79 | | | | | | | |
| 108 Ag silver 47 | | | | | | | |
| 106 Pd palladium 46 | | | | | | | |
| 103 Rh rhodium 45 | | | | | | | |
| 101 Ru ruthenium 44 | | | | | | | |
| [98] Tc technetium 43 | | | | | | | |
| 56 Fe iron 26 | | | | | | | |
| 59 Co cobalt 27 | | | | | | | |
| 59 Ni nickel 28 | | | | | | | |
| 63.5 Cu copper 29 | | | | | | | |
| 65 Zn zinc 30 | | | | | | | |
| [55] Mn manganese 25 | | | | | | | |
| 52 Cr chromium 24 | | | | | | | |
| 51 V vanadium 23 | | | | | | | |
| 48 Ti titanium 22 | | | | | | | |
| 45 Sc scandium 21 | | | | | | | |
| 91 Zr zirconium 40 | | | | | | | |
| 93 Nb niobium 41 | | | | | | | |
| 96 Mo molybdenum 42 | | | | | | | |
| 101 Ru ruthenium 44 | | | | | | | |
| 103 Rh rhodium 45 | | | | | | | |
| 106 Pd palladium 46 | | | | | | | |
| 112 Cd cadmium 48 | | | | | | | |
| 115 In indium 49 | | | | | | | |
| 119 Sn tin 50 | | | | | | | |
| 122 Sb antimony 51 | | | | | | | |
| 128 Te tellurium 52 | | | | | | | |
| 127 I iodine 53 | | | | | | | |
| 131 Xe xenon 54 | | | | | | | |
| 133 Cs caesium 55 | | | | | | | |
| 137 Ba barium 56 | | | | | | | |
| 139 La* lanthanum 57 | | | | | | | |
| 89 Y yttrium 39 | | | | | | | |
| 88 Sr strontium 38 | | | | | | | |
| 40 Ca calcium 20 | | | | | | | |
| 39 K potassium 19 | | | | | | | |
| 24 Mg magnesium 12 | | | | | | | |
| 23 Na sodium 11 | | | | | | | |
| 9 Be beryllium 4 | | | | | | | |
| 7 Li lithium 3 | | | | | | | |

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.