



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

# General Certificate of Secondary Education

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## Chemistry

### Specimen Papers and Mark Schemes

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The specimen assessment materials accompanying the new AQA GCSE Sciences specifications are provided to give centres a reasonable idea of the general shape and character of the planned question papers in advance of the first operational examinations.

Surname						Other Names					
Centre Number						Candidate Number					
Candidate signature											

General Certificate of Secondary Education  
Specimen Paper



**SCIENCE A**  
**Products from Rocks (Unit Chemistry 1a)**

Date and Time

**For this paper you must have:**

- a black ball-point pen
- an objective test answer sheet

You may use a calculator.

Time allowed: 30 minutes

**Instructions**

- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title ‘Products from Rocks’ printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only.
- Do all rough work in this book, **not** on your answer sheet.

**Instructions for recording answers**

- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

**Information**

- The maximum mark for this paper is 36.

**Advice**

- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

---

You must do **one Tier** only, **either** the Foundation tier **or** the Higher Tier.  
The Higher Tier starts on page 14 of this booklet.

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**FOUNDATION TIER**

**SECTION A**

Questions **ONE** to **SIX**.

In these questions match the letters with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

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**QUESTION ONE**

The table is about raw materials and substances made from them.

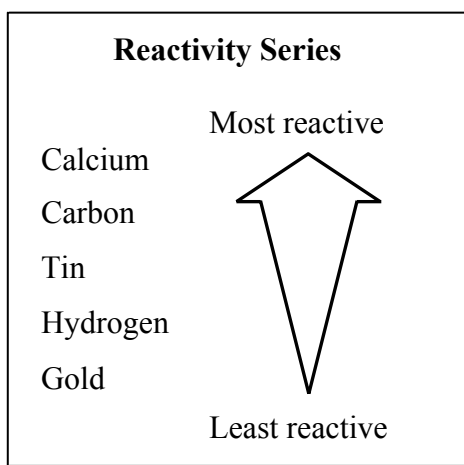
Match words, **A**, **B**, **C** and **D**, with the numbers **1 – 4** in the table.

- A** Concrete
- B** Glass
- C** Limestone
- D** Slaked Lime

<b>Substance</b>	<b>What we can say about the substance</b>
<b>1</b>	It is made by heating together limestone, sand and soda
<b>2</b>	It is made from cement and used as a building material
<b>3</b>	It is made from quicklime and used to reduce the acidity of soils
<b>4</b>	It is quarried rock used as building material

**QUESTION TWO**

The diagram shows the reactivity of some elements.



Match the words, **A**, **B**, **C** and **D**, with the numbers **1** – **4** in the table.

- A** Calcium
- B** Carbon
- C** Gold
- D** Tin

<b>1</b>	A metal that can be extracted from its ore by carbon but not by hydrogen
<b>2</b>	A metal that cannot be extracted from its ore by using carbon
<b>3</b>	A solid non-metal
<b>4</b>	It may be found in the ground as the metal itself

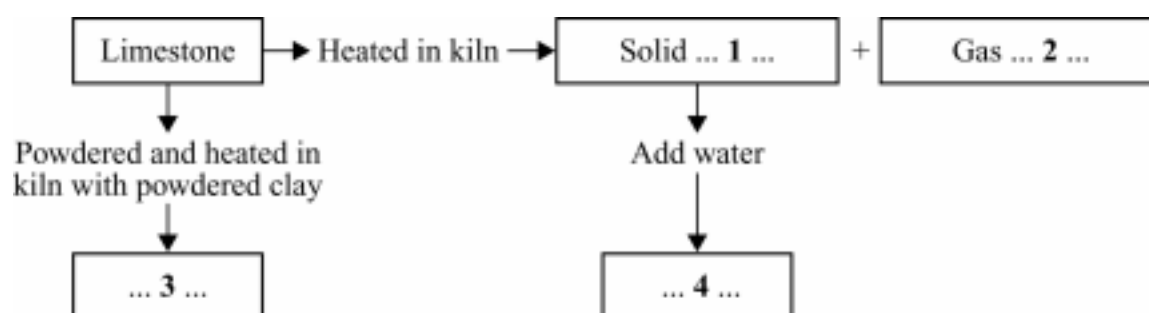
**Turn over for the next question**

**QUESTION THREE**

The flow chart shows some of the substances that can be made from limestone.

Match words, **A**, **B**, **C** and **D**, with the spaces **1 – 4** in the flow chart.

- A** Calcium Hydroxide
- B** Calcium Oxide
- C** Carbon Dioxide
- D** Cement





**QUESTION FOUR**

Atoms join to other atoms to form molecules.

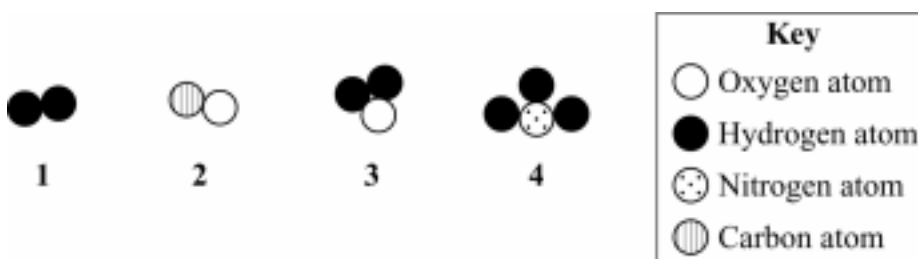
Match formulae, **A**, **B**, **C** and **D**, with the diagrams **1** – **4**.

**A** CO

**B** H<sub>2</sub>

**C** H<sub>2</sub>O

**D** NH<sub>3</sub>



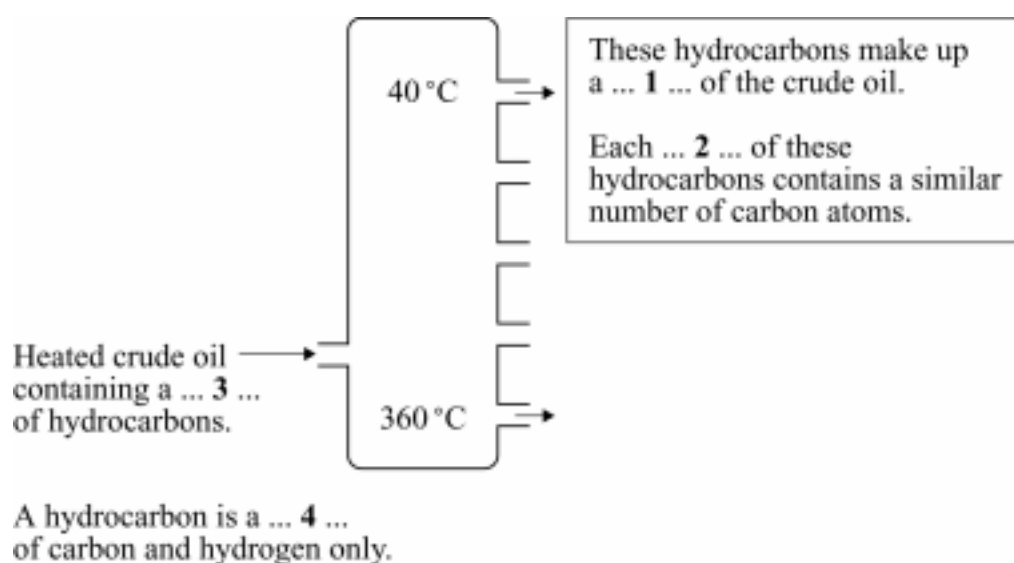
**Turn over for the next question**

**QUESTION FIVE**

We can get useful products from crude oil.

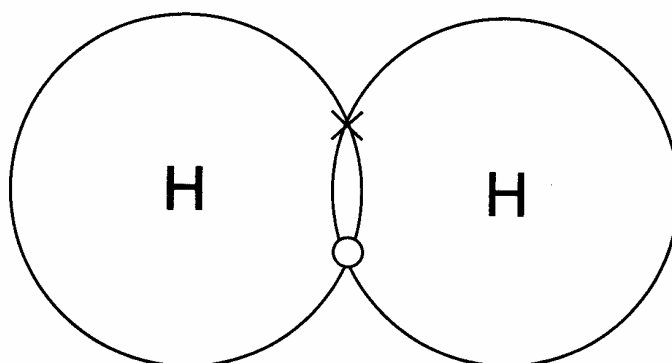
Match words, **A**, **B**, **C** and **D**, with the labels **1** – **4** on the diagram.

- A** Compound
- B** Fraction
- C** Mixture
- D** Molecule



**QUESTION SIX**

The diagram shows a molecule of hydrogen.



Match words, **A**, **B**, **C** and **D**, with the spaces **1** – **4** in the sentences.

- A** Bond
- B** Electron
- C** Molecule
- D** Nucleus

Each hydrogen atom has a small, central ... **1** ... .

The two hydrogen atoms each share an ... **2** ... .

This sharing forms a chemical ... **3** ... between the two atoms.

The two joined atoms form a ... **4** ... .

**Turn over for the next question**

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**SECTION B**Questions **SEVEN** to **NINE**.

Each of these questions has four parts.

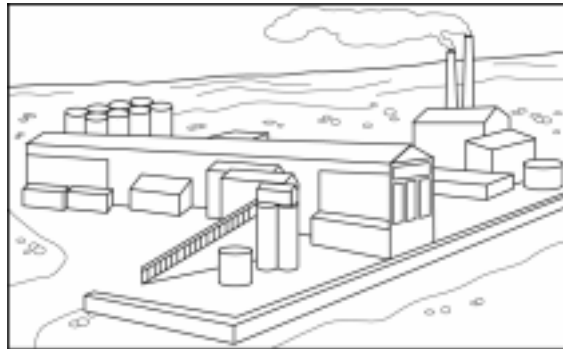
In each part choose only **one** answer.Mark your choices on the answer sheet.

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**QUESTION SEVEN**

Producing cement affects the environment.

The drawing shows a cement works next to a limestone quarry.

**7.1** Quarrying limestone affects the environment at this site mainly by causing . . .

- A** air pollution.
- B** land pollution.
- C** visual pollution.
- D** water pollution.

7.2 Producing cement in the kiln will produce . . .

- A air pollution.
- B land pollution.
- C noise pollution.
- D water pollution.

7.3 Producing cement at this site uses . . .

- A energy resources only.
- B energy resources and renewable materials.
- C energy sources and non-renewable materials.
- D renewable materials only.

7.4 The cement is transported away from the works by a fleet of lorries.

The lorries cause mainly . . .

- A air pollution and land pollution.
- B air pollution and noise pollution.
- C air pollution and visual pollution.
- D air pollution and water pollution.

**Turn over for the next question**

**QUESTION EIGHT**

Julie heated some limestone.

The limestone decomposed to form calcium oxide and carbon dioxide.

The limestone was weighed before and after being heated.

The table shows Julie's results.

	<b>Experiment 1</b>	<b>Experiment 2</b>
<b>Mass of limestone before heating in grams</b>	2.00	2.00
<b>Mass of limestone after heating in grams</b>	1.12	
<b>Mass lost in grams</b>	0.88	0.90

**8.1** Which type of balance would be best for doing this experiment?

- A** 0 – 100 g measuring to the nearest 0.01 g
- B** 0 – 100 g measuring to the nearest 0.1 g
- C** 0 – 500 g measuring to the nearest g
- D** 0 – 1000 g measuring to the nearest 10 g

**8.2** What was the mass of limestone after heating in **Experiment 2**?

- A** 0.88 g
- B** 0.90 g
- C** 1.10 g
- D** 1.12 g

**8.3** What mass of carbon dioxide was formed in **Experiment 1**?

- A 0.88 g
- B 0.90 g
- C 1.10 g
- D 1.12 g

**8.4** What is the best conclusion to Julie's experiment?

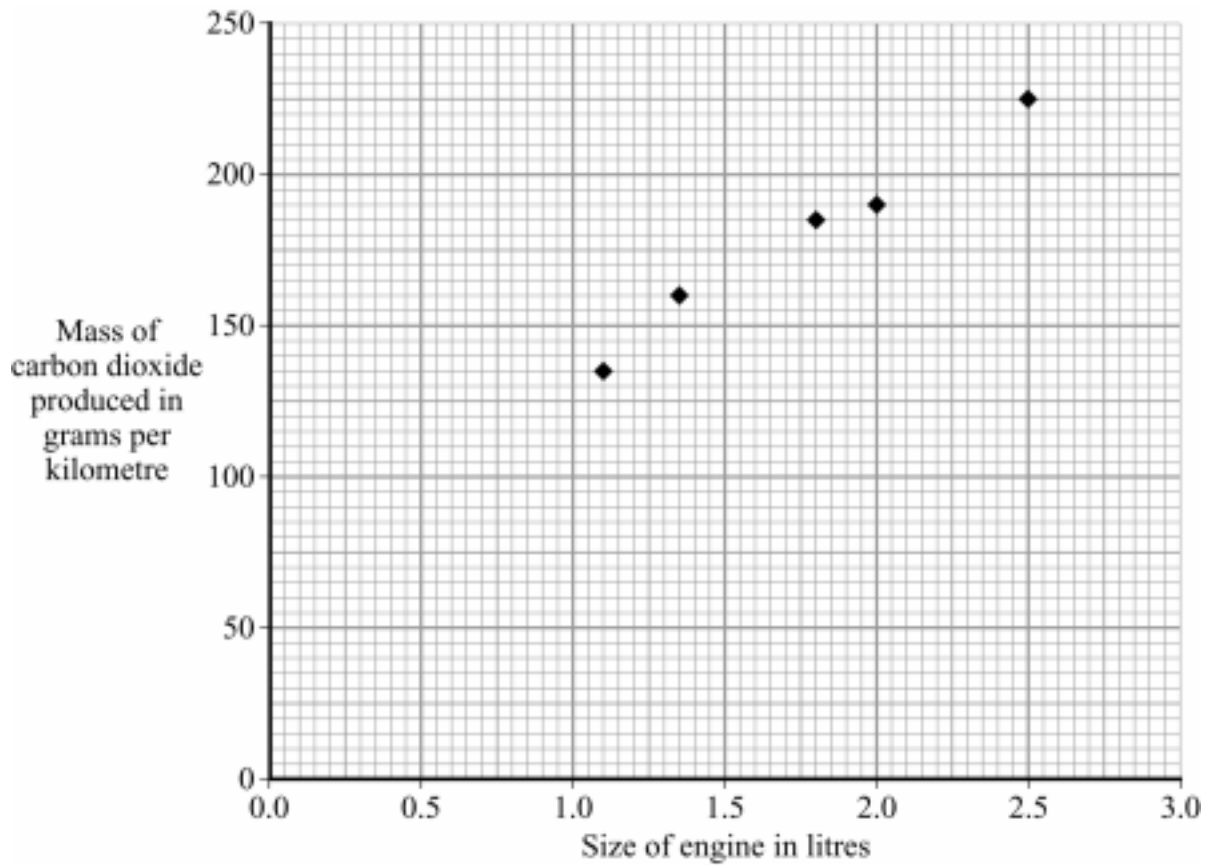
- A Heating 2.00 g of limestone results in a loss in mass of 0.88 g.
- B Heating 2.00 g of limestone results in a loss in mass of 0.90 g.
- C Heating 2.00 g of limestone results in an average loss of 0.89 g.
- D Heating 2.00 g of limestone results in a different loss in mass each time.

**Turn over for the next question**

**QUESTION NINE**

Most cars use either petrol or diesel as fuel.

The graph gives information about the mass of carbon dioxide produced by different sizes of petrol engine.



**9.1** What mass of carbon dioxide is produced by a car with a 2.0 litre petrol engine on a 10km school run?

- A 155 g
- B 190 g
- C 1900 g
- D 2350 g



**9.2** What is the best estimate of the mass of carbon dioxide that would be produced by a 1.0 litre petrol engine?

- A 60 grams per kilometre
- B 125 grams per kilometre
- C 140 grams per kilometre
- D 170 grams per kilometre

**9.3** What is the relationship, if any, between petrol engine size and the mass of carbon dioxide produced?

- A They are directly proportional.
- B They are inversely proportional.
- C There is a correlation between engine size and mass of carbon dioxide produced.
- D There is no relationship between the two.

**9.4** A 2.0 litre diesel engine produces 156 grams of carbon per kilometre.

What is the best conclusion that can be drawn from this?

- A Diesel engines produce less carbon dioxide than petrol engines.
- B Petrol engines produce less carbon dioxide than diesel engines.
- C The mass of carbon dioxide produced by an engine depends on both the size of the engine and the type of fuel.
- D The mass of carbon dioxide produced by an engine depends only on the type of fuel.

**END OF TEST**

---

You must do **one Tier** only, **either** the Foundation tier **or** the Higher Tier.  
The Foundation Tier is earlier in this booklet.

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## HIGHER TIER

### SECTION A

Questions **ONE** and **TWO**

In these questions match the letters with the numbers.

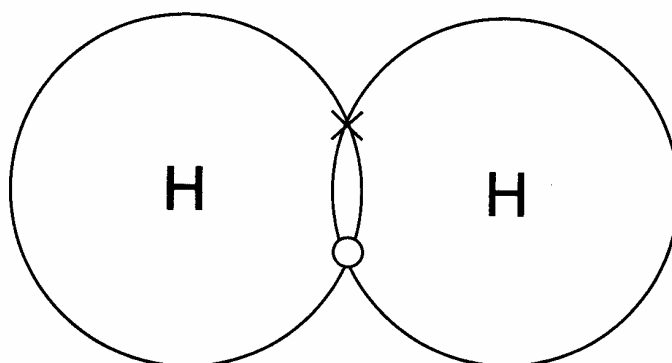
Use **each** answer only **once**.

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#### QUESTION ONE

The diagram shows a molecule of hydrogen.



Match words, **A**, **B**, **C** and **D**, with the spaces **1** – **4** in the sentences.

- A** Bond
- B** Electron
- C** Molecule
- D** Nucleus

Each hydrogen atom has a small, central ... **1** ... .

The two hydrogen atoms each share an ... **2** ... .

This sharing forms a chemical ... **3** ... between the two atoms.

The two joined atoms form a ... **4** ... .

**QUESTION TWO**

Use words from the list to complete the sentences.

- A** Condense
- B** Evaporation
- C** Fractional distillation
- D** Fractions

The many hydrocarbons in crude oil may be separated into ... **1** ... ,  
each of which contain molecules with a similar number of carbon atoms,  
by ... **2** ... of the oil and allowing it to ... **3** ... at a number of different temperatures.  
This process is called ... **4** ... .

**Turn over for the next question**

**SECTION B**Questions **THREE** to **NINE**.

Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

**QUESTION THREE**

Julie heated some limestone.

The limestone decomposed to form calcium oxide and carbon dioxide.

The limestone was weighed before and after being heated.

The table shows Julie's results.

	<b>Experiment 1</b>	<b>Experiment 2</b>
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<b>Mass lost in grams</b>	0.88	0.90

**3.1** Which type of balance would be best for doing this experiment?

- A** 0 – 100 g measuring to the nearest 0.01 g
- B** 0 – 100 g measuring to the nearest 0.1 g
- C** 0 – 500 g measuring to the nearest g
- D** 0 – 1000 g measuring to the nearest 10 g

**3.2** What was the mass of limestone after heating in **Experiment 2**?

- A** 0.88 g
- B** 0.90 g
- C** 1.10 g
- D** 1.12 g

**3.3** What mass of carbon dioxide was formed in **Experiment 1**?

- A 0.88 g
- B 0.90 g
- C 1.10 g
- D 1.12 g

**3.4** What is the best conclusion to Julie's experiment?

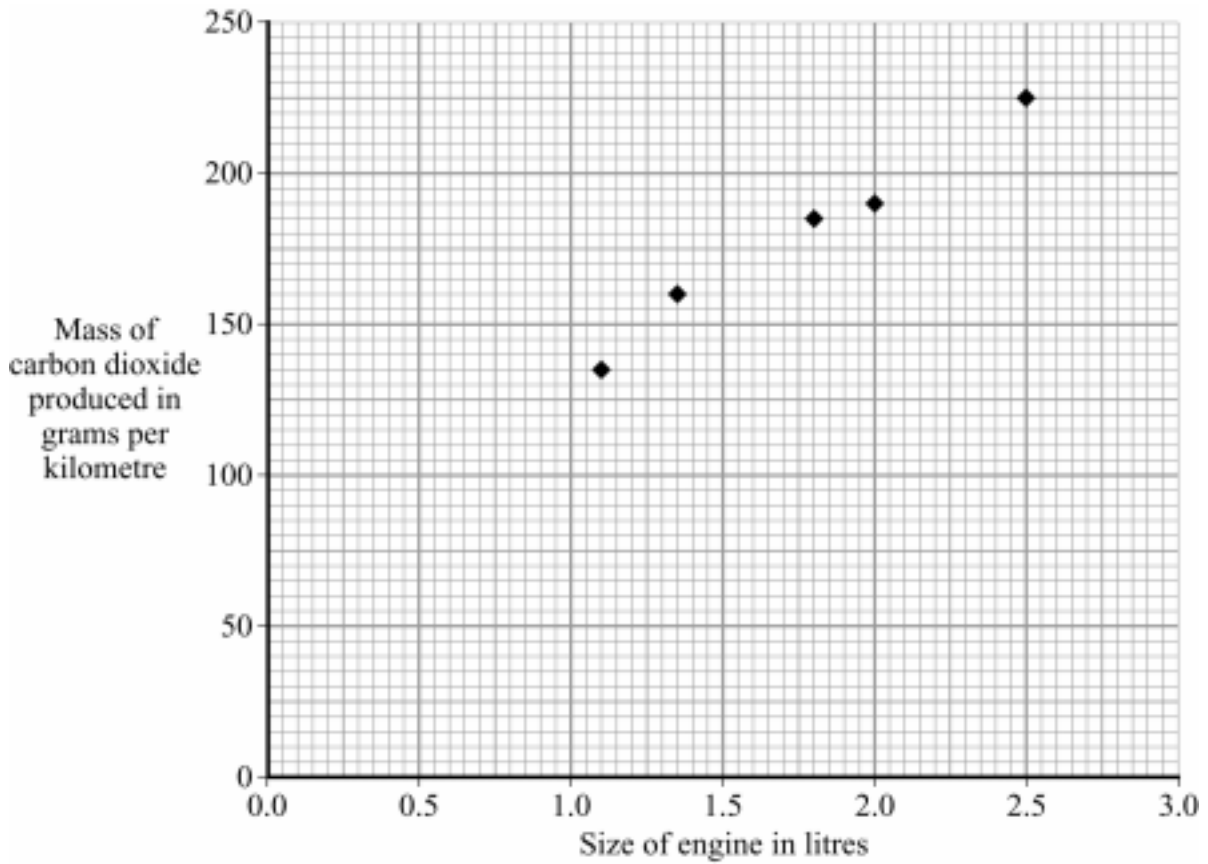
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**Turn over for the next question**

**QUESTION FOUR**

Most cars use either petrol or diesel as fuel.

The graph gives information about the mass of carbon dioxide produced by different sizes of petrol engine.



4.1 What mass of carbon dioxide is produced by a car with a 2.0 litre petrol engine on a 10 km school run?

- A 155 g
- B 190 g
- C 1900 g
- D 2350 g

---

**4.2** What is the best estimate of the mass of carbon dioxide that would be produced by a 1.0 litre petrol engine?

- A** 60 grams per kilometre
- B** 125 grams per kilometre
- C** 140 grams per kilometre
- D** 170 grams per kilometre

**4.3** What is the relationship, if any, between petrol engine size and the mass of carbon dioxide produced?

- A** They are directly proportional.
- B** They are inversely proportional.
- C** There is a correlation between engine size and mass of carbon dioxide produced.
- D** There is no relationship between the two.

**4.4** A 2.0 litre diesel engine produces 156 grams of carbon per kilometre.

What is the best conclusion that can be drawn from this?

- A** Diesel engines produce less carbon dioxide than petrol engines.
- B** Petrol engines produce less carbon dioxide than diesel engines.
- C** The mass of carbon dioxide produced by an engine depends on both the size of the engine and the type of fuel.
- D** The mass of carbon dioxide produced by an engine depends only on the type of fuel.

**Turn over for the next question**

**QUESTION FIVE**

This question is about burning and the products of burning.

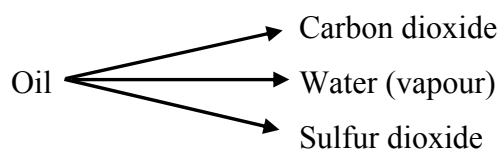
**5.1** About 20 % of the air is ...

- A** carbon dioxide.
- B** nitrogen.
- C** oxygen.
- D** sulfur dioxide.

**5.2** When carbon in a fuel burns in air the reaction can be represented by this word equation:

- A** carbon + oxygen → carbonic acid
- B** carbon dioxide → carbon + oxygen
- C** carbon + oxygen → carbon dioxide
- D** carbon + oxygen → calcium carbonate

**5.3** These are the three main substances produced when most fuels are burned:



The products of these reactions are all ...

- A** carbonates.
- B** hydroxides.
- C** oxides.
- D** sulfides.



**5.4** Burning fuels release solid particles which ...

- A** cause acid rain.
- B** cause global dimming.
- C** cause global warming.
- D** cause water pollution.

**Turn over for the next question**

**QUESTION SIX**

Alloys often have more useful properties than pure metals.

**6.1** Mixtures of metals are called . . .

- A** alloys.
- B** catalysts.
- C** compounds.
- D** ores.

**6.2** One metal mixed with iron to make stainless steel is . . .

- A** aluminium.
- B** calcium.
- C** chromium.
- D** potassium.

**6.3** Low carbon steel is . . .

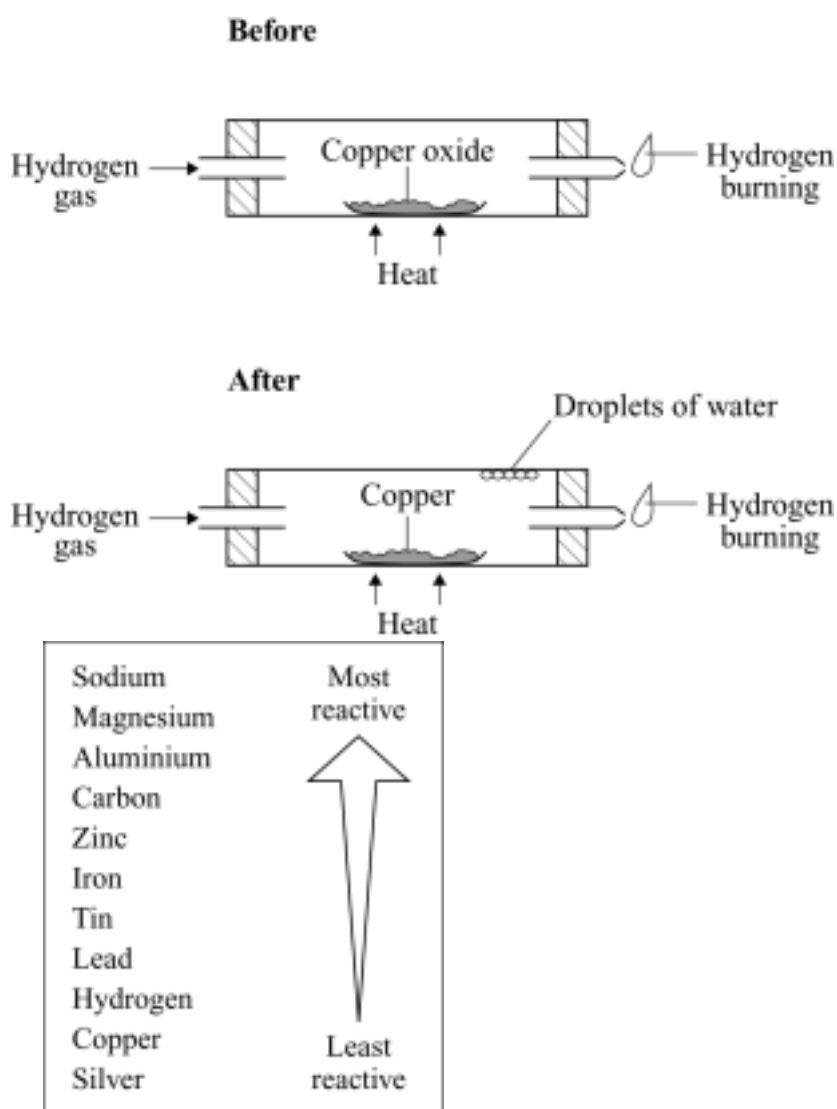
- A** easily shaped.
- B** hard.
- C** resistant to corrosion.
- D** resistant to staining.

**6.4** Smart alloys . . .

- A** can adapt to new situations.
- B** can easily be bent.
- C** can resist most chemicals.
- D** can return to their original shape after being deformed.

## QUESTION SEVEN

The drawings show how hydrogen can be used to displace a metal from one of its compounds.



7.1 In the reaction shown, the hydrogen is . . .

- A dehydrated.
- B neutralised.
- C oxidised.
- D reduced.

7.2 The symbol equation for the reaction is . . .

- A  $\text{Cu} + \text{H}_2 \rightarrow \text{CuO}$
- B  $\text{Cu} + \text{H}_2 \rightarrow \text{CuO} + \text{H}_2\text{O}$
- C  $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$
- D  $\text{CuO} + \text{H}_2\text{O} \rightarrow \text{Cu} + \text{H}_2$

7.3 Which of these metals could be displaced from its oxide by carbon but not by hydrogen?

- A Aluminium
- B Lead
- C Magnesium
- D Sodium

7.4 Which metal cannot be extracted from its oxide using carbon?

- A Copper
- B Sodium
- C Tin
- D Zinc

**Turn over for the next question**

**QUESTION EIGHT**

Crude oil can be separated into fractions.

Each fraction contains several different hydrocarbons.

<b>Fraction of crude oil</b>	<b>Number of carbon atoms in each hydrocarbon molecule</b>
Petrol	$C_4 - C_{12}$
Paraffin	$C_{11} - C_{15}$
Diesel oil	$C_{14} - C_{19}$
Bitumen	$C_{50}$ and upwards

**8.1** Crude oil can be separated into fractions by fractional distillation because . . .

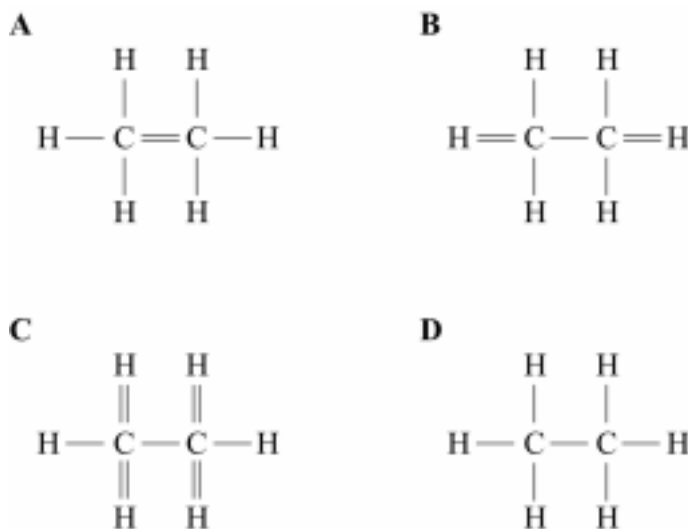
- A the fractions flow at different rates.
- B the fractions have different boiling points.
- C the fractions have different colours.
- D the fractions have different densities.

**8.2** Hydrocarbons with the smallest molecules will be found in . . .

- A the bitumen fraction.
- B the diesel fraction.
- C the paraffin fraction.
- D the petrol fraction.

The formula for hydrocarbon **X** is  $C_2H_6$

**8.3** The structural formula for hydrocarbon **X** is . . .



**8.4** Which of these hydrocarbons belongs to the same group as hydrocarbon **X**?

- A**  $C_3H_8$
- B**  $C_4H_8$
- C**  $C_5H_{10}$
- D**  $C_6H_{12}$

**Turn over for the next question**

**QUESTION NINE**

Read the information below about recycling metals.

Recycling scrap steel reduces related water pollution, air pollution and mining wastes by about 70%. It takes four times as much energy to make steel from iron ore than from recycled steel.

Recycling cans made from tin-plated steel saves 74% of the energy needed to produce these cans from raw materials. 80% of the tin is recovered from recycled cans.

Every time a tonne of steel is recycled, 2000 kg of iron ore, 500 kg of coal and 20 kg of limestone are conserved.

The recycling process simply involves melting the scrap steel then removing impurities.

**9.1** What mass of raw materials is preserved when one tonne of steel is recycled?

- A 20 kg
- B 500 kg
- C 2000 kg
- D 2520 kg

**9.2** A tin-coated can has a mass of 10 g. 1% of this mass is tin.

How much tin is saved by the recycling of one tin can?

- A 0.008 g
- B 0.08 g
- C 0.8 g
- D 8.0g



**9.3** In the manufacture of iron, carbon is used to displace oxygen from iron oxide.

Which pollutant gas is formed during this reaction?

- A** Carbon dioxide
- B** Nitrogen
- C** Oxygen
- D** Sulfur dioxide

**9.4** Recycling scrap needs much less energy than making steel from iron ore.

This is because . . .

- A** iron in iron ore needs to be oxidised.
- B** iron in scrap iron has already been displaced from its oxide.
- C** iron in scrap iron only needs to be oxidised.
- D** there are fewer impurities in scrap iron.

**END OF TEST**

**GCSE SCIENCE A**  
**OBJECTIVE TEST ANSWER KEY**  
**UNIT CHEMISTRY 1a - FOUNDATION TIER**

Question No.	KEY
One	1 – B 2 – A 3 – D 4 – C
Two	1 – D 2 – A 3 – B 4 – C
Three	1 – B 2 – C 3 – D 4 – A
Four	1 – B 2 – A 3 – C 4 – D
Five	1 – B 2 – D 3 – C 4 – A
Six	1 – D 2 – B 3 – A 4 – C
Seven	7.1 – C, 7.2 – A, 7.3 – C, 7.4 – B
Eight	8.1 – A, 8.2 – C, 8.3 – A, 8.4 – C
Nine	9.1 – C, 9.2 – B, 9.3 – C, 9.4 – C
<b>Overall marks = 36</b>	

**GCSE SCIENCE A**  
**OBJECTIVE TEST ANSWER KEY**

**UNIT CHEMISTRY 1a - HIGHER TIER**

<b>Question No.</b>	<b>KEY</b>
One	1 – D 2 – B 3 – A 4 – C
Two	1 – D 2 – B 3 – A 4 – C
Three	3.1 – A, 3.2 – C, 3.3 – A, 3.4 – C
Four	4.1 – C, 4.2 – B, 4.3 – C, 4.4 – C
Five	5.1 – C, 5.2 – C, 5.3 – C, 5.4 – B
Six	6.1 – A, 6.2 – C, 6.3 – A, 6.4 – D
Seven	7.1 – C, 7.2 – C, 7.3 – B, 7.4 – B
Eight	8.1 – B, 8.2 – D, 8.3 – D, 8.4 – A
Nine	9.1 – D, 9.2 – B, 9.3 – A, 9.4 – B
	<b>Overall marks = 36</b>

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Surname					Other Names				
Centre Number					Candidate Number				
Candidate signature									



General Certificate of Secondary Education  
Specimen Paper

**SCIENCE A**  
**Oils, Earth and Atmosphere (Unit Chemistry 1b)**

Date and Time

**For this paper you must have:**

- a black ball-point pen
- an objective test answer sheet

You may use a calculator.

Time allowed: 30 minutes

**Instructions**

- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title ‘Oils, Earth and Atmosphere’ printed on it.
- Attempt **one Tier only, either** the Foundation Tier **or** the Higher Tier.
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**Instructions for recording answers**

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1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
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1	2	3	4
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<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

**Information**

- The maximum mark for this paper is 36.

**Advice**

- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
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You must do **one Tier** only, **either** the Foundation tier **or** the Higher Tier.  
The Higher Tier starts on page 14 of this booklet.

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## FOUNDATION TIER

### SECTION A

Questions **ONE** to **SIX**.

In these questions match words in the list with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

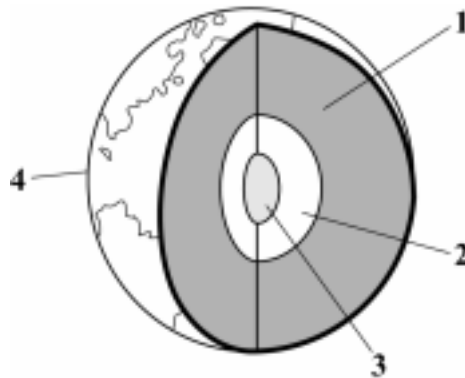
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### QUESTION ONE

The drawing shows the layered structure of the Earth.

Match words, **A**, **B**, **C** and **D**, with the labels **1** – **4** on the diagram.

- A** Crust
- B** Inner core
- C** Mantle
- D** Outer Core

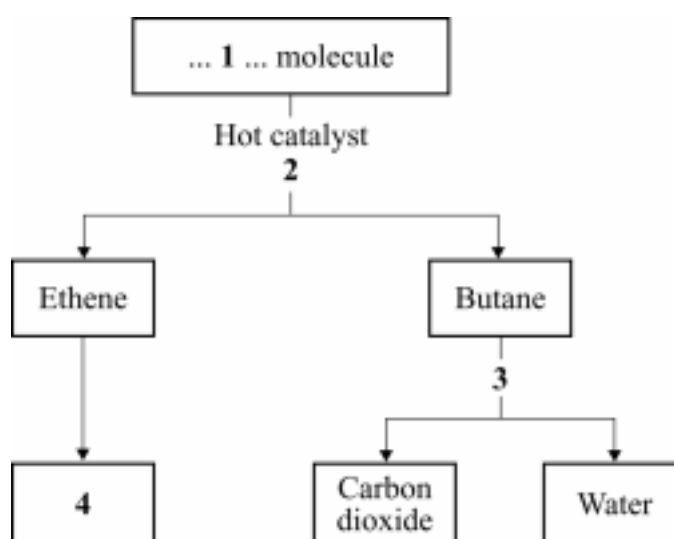


**QUESTION TWO**

The flow diagram shows the reactions of some molecules from crude oil.

Match words, **A**, **B**, **C**, and **D**, with the labels **1 – 4** on the diagram.

- A** Burning
- B** Cracking
- C** Hydrocarbon
- D** Poly(ethene)



**Turn over for the next question**

---

**QUESTION THREE**

Plant oils have many uses.

Match words, **A**, **B**, **C** and **D**, with the spaces **1** – **4** in the sentences.

**A** A fuel

**B** An emulsion

**C** Energy

**D** Temperature

Vegetable oil can be burned as ...**1**...

Vegetable oils are useful foods because they contain a lot of ...**2**...

Vegetable oils cook food at a higher ...**3**... than water.

In some foods, vegetable oil is mixed with another liquid to form ...**4**...

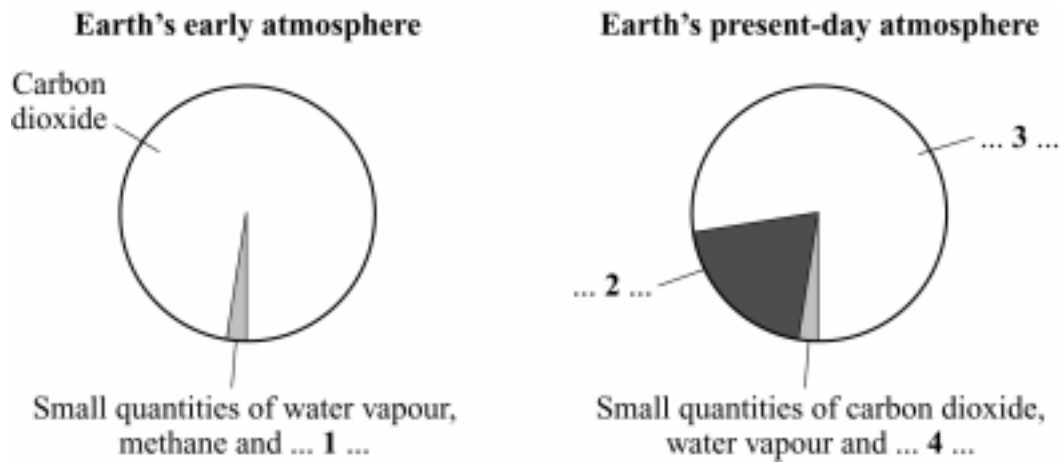


**QUESTION FOUR**

The pie charts show the gases in the Earth's early atmosphere and the Earth's present-day atmosphere.

Match words, **A**, **B**, **C** and **D**, with the labels **1 – 4** on the diagram.

- A** Ammonia
- B** Nitrogen
- C** Noble gases
- D** Oxygen



**Turn over for the next question**

**QUESTION FIVE**

This question is about tectonic plates.

Match words, **A**, **B**, **C** and **D**, with the spaces **1 – 4** in the sentences.

- A** Continental drift
- B** Convection currents
- C** Radioactive processes
- D** Volcanic eruptions

Wegener suggested that in the past there was a single, large landmass.

This split up and the smaller landmasses moved apart. We call this process ...**1**...

Tectonic plates move because of ...**2**... in the Earth's mantle.

The heat required for this movement to occur comes from natural ...**3**...

At the boundaries between the tectonic plates, there are often ...**4**...

**QUESTION SIX**

The table gives some information about four different vegetable oils.  
Iodine number is the number of unsaturated bonds in a molecule of the oil.  
Cetane number is a measure of how easy it is to ignite the oil.  
Oils with low cetane numbers do not ignite easily.

Match words, **A**, **B**, **C** and **D**, with the numbers **1** – **4** in the table.

- A** The oil which is solid at room temperature
- B** The oil which would be the hardest to ignite
- C** The oil with the least double bonds
- D** The oil with the lowest melting point

	<b>Name of oil</b>	<b>Melting point in °C</b>	<b>Iodine number</b>	<b>Cetane number</b>
<b>1</b>	Olive oil	-12	60	52
<b>2</b>	Palm oil	35	63	65
<b>3</b>	Rapeseed oil	5	100	45
<b>4</b>	Sunflower oil	-18	130	60

**Turn over for the next question**

---

**SECTION B**Questions **SEVEN** to **NINE**.

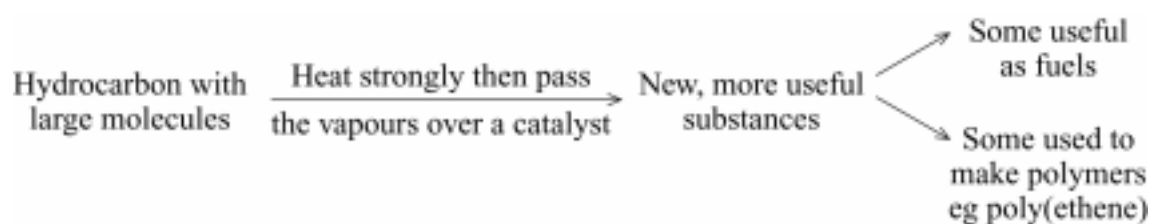
Each of these questions has four parts.

In each part choose only **one** answer.Mark your choices on the answer sheet.

---

**QUESTION SEVEN**

Hydrocarbons with large molecules can be broken down into more useful substances.



7.1 What name is given to this process in which large hydrocarbon molecules are broken down?

- A Cracking
- B Evaluation
- C Oxidation
- D Polymerisation

7.2 One use of poly(ethene) is to make . . .

- A crates.
- B pans.
- C plastic bags.
- D ropes.

7.3 Burying waste poly(ethene) is not a good way to get rid of it.

This is because . . .

- A it does not flow easily.
- B it has a high boiling point.
- C it is insoluble in water.
- D it is not biodegradable.

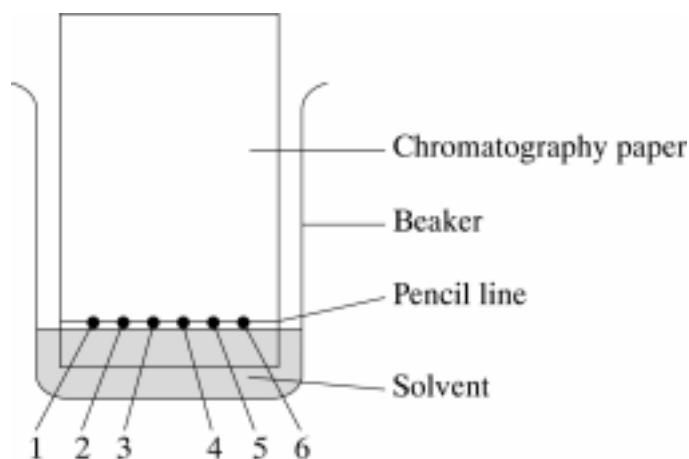
7.4 When cardboard and paper waste are buried in the ground, they . . .

- A are broken down by microorganisms.
- B are dissolved by soil water.
- C ignite spontaneously.
- D release sulfur dioxide gas.

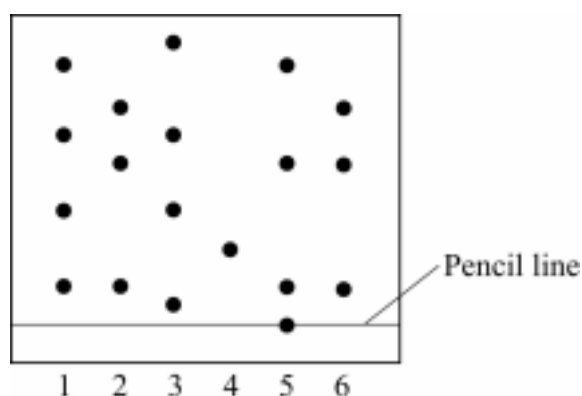
**Turn over for the next question**

**QUESTION EIGHT**

Jane used chromatography to investigate the colours used in six different sweets, 1 – 6. A pencil line was drawn near the bottom of the chromatography paper. Jane placed a few drops of extract from each of the foods on this line. The paper was then dipped into some solvent in a beaker.



The diagram below shows the chromatogram obtained at the end of the experiment.



**8.1** Which two sweets probably contained the same mixture of dyes?

- A** 1 and 3
- B** 1 and 5
- C** 2 and 6
- D** 3 and 5

- 8.2** What is the best conclusion that Jane could draw about sweet 5?
- A** Sweet 5 contains four dyes.
  - B** Sweet 5 probably contains four dyes.
  - C** Sweet 5 contains at least four dyes.
  - D** Sweet 5 contains a maximum of four dyes.
- 8.3** Which of the following would give the most accurate measure of the distance moved by a dye?
- A** A metre rule
  - B** A micrometer
  - C** A pair of dividers and a millimetre rule
  - D** A piece of 2 mm graph paper
- 8.4** What is the best way of doing a survey to find which children's drinks on sale in the UK contain a particular dye?
- A** Ask mothers at a local toddler group
  - B** Do an internet search
  - C** Look on the shelves in the local supermarket
  - D** Write to as many food manufacturers as you can find in yellow pages

**Turn over for the next question**

**QUESTION NINE**

Read the passage below about cooking with oils.

Cooking at high temperatures can damage oils. The more omega 3 fatty acids in the oil, the less suitable it is for cooking. The heat not only damages the fatty acids, but it can also change them into harmful substances. Hydrogenated oils are often used for cooking. Since these oils have already been “damaged” by chemical processing, they are less likely to be further damaged by heat. The oils that are higher in saturated fats are the most stable when heated. These include peanut oil and olive oil. The more fragile oils are best used at room temperature, like salad dressings.

To preserve the nutritious properties and the flavour of unrefined oils, try the “wet-sauté”. Pour around one-fourth of a cup of water in the stir-fry pan and heat just below boiling. Then add the food and cook it a little before adding the oil. Wet-sauté shortens the time oil is in contact with a hot pan. Stir frequently to further reduce the time the oil is in contact with the hot metal. Never heat oils to the smoking point, as this not only damages their fatty acid content but also their taste.

**9.1 Heating oils to smoking point . . .**

- A** damages their fatty acid content.
- B** is best for cooking chips.
- C** is best for making salad oil.
- D** turns them into margarine.

**9.2 Wet-sauté . . .**

- A** damages oils.
- B** is best for cooking chips.
- C** is best for saturated oils.
- D** is best for unsaturated oils.



**9.3** A hydrogenated oil . . .

- A** contains hydrogen.
- B** contains only carbon.
- C** has a better taste.
- D** is saturated.

**9.4** Hydrogenated oils have been ‘damaged’ by chemical processing.

In this processing, . . .

- A** unsaturated oils are frozen to make them solid.
- B** unsaturated oils are gently heated with hydrogen in the presence of a catalyst.
- C** unsaturated oils are heated to a high temperature.
- D** vapour from unsaturated oils is passed over a hot catalyst.

**END OF TEST**

---

You must do **one Tier** only, **either** the Foundation tier **or** the Higher Tier.  
The Foundation Tier is earlier in this booklet.

---

## HIGHER TIER

### SECTION A

Questions **ONE** and **TWO**.

In these questions match the letters with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

---

#### QUESTION ONE

The table gives some information about four different vegetable oils.  
Iodine number is the number of unsaturated bonds in a molecule of the oil.  
Cetane number is a measure of how easy it is to ignite the oil.  
Oils with low cetane numbers do not ignite easily.

Match words, **A**, **B**, **C** and **D**, with the numbers **1 – 4** in the table.

- A** The oil which is solid at room temperature
- B** The oil which would be the hardest to ignite
- C** The oil with the least double bonds
- D** The oil with the lowest melting point

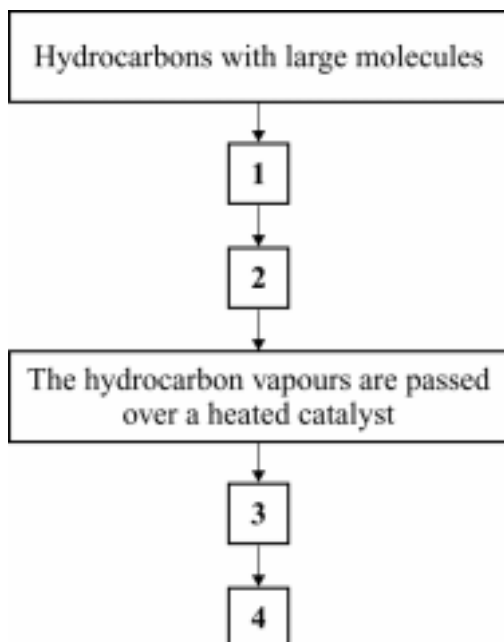
	Name of oil	Melting point in °C	Iodine number	Cetane number
<b>1</b>	Olive oil	-12	60	52
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<b>3</b>	Rapeseed oil	5	100	45
<b>4</b>	Sunflower oil	-18	130	60

**QUESTION TWO**

The diagram shows stages in the cracking of hydrocarbons.

Match words, **A**, **B**, **C**, and **D**, with the spaces **1 – 4**, to describe what happens in this process.

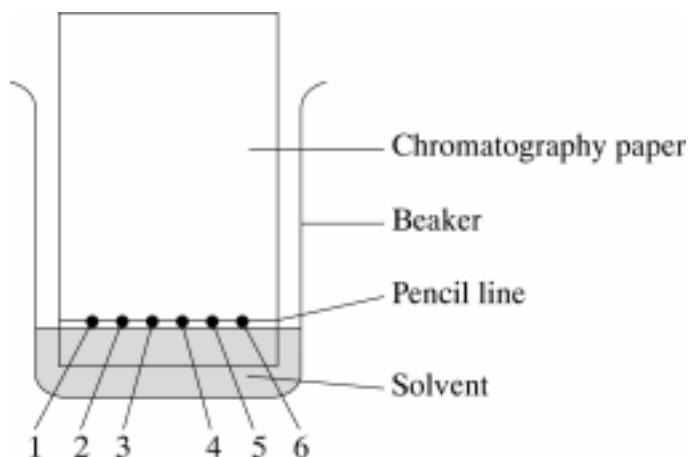
- A** Hydrocarbons with small molecules
- B** The hydrocarbons are heated.
- C** The hydrocarbons are in a vapour state.
- D** Thermal decomposition of hydrocarbons



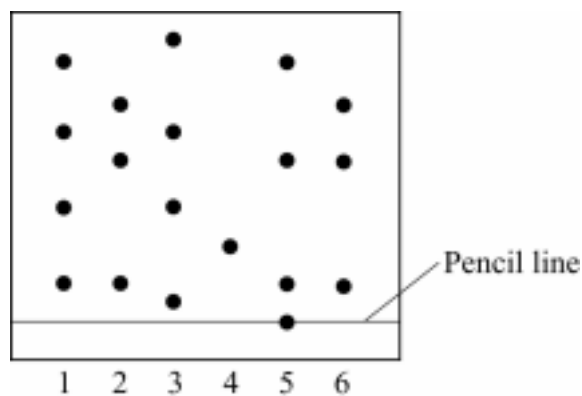
**Turn over for the next question**

**QUESTION THREE**

Jane used a chromatography to investigate the colours used in six different sweets, 1 – 6. A pencil line was drawn near the bottom of the chromatography paper. Jane placed a few drops of extract from each of the foods on this line. The paper was then dipped into some solvent in a beaker.



The diagram below shows the chromatogram obtained at the end of the experiment.



**3.1** Which two sweets probably contained the same mixture of dyes?

- A** 1 and 3
- B** 1 and 5
- C** 2 and 6
- D** 3 and 5

**3.2** What is the best conclusion that Jane could draw about sweet 5?

- A** Sweet 5 contains four dyes.
- B** Sweet 5 probably contains four dyes.
- C** Sweet 5 contains at least four dyes.
- D** Sweet 5 contains a maximum of four dyes.

**3.3** Which of the following would give the most accurate measure of the distance moved by a dye?

- A** A metre rule
- B** A micrometer
- C** A pair of dividers and a millimetre rule
- D** A piece of 2 mm graph paper

**3.4** What is the best way of doing a survey to find which children's drinks on sale in the UK contain a particular dye?

- A** Ask mothers at a local toddler group
- B** Do an internet search
- C** Look on the shelves in the local supermarket
- D** Write to as many food manufacturers as you can find in yellow pages

**Turn over for the next question**

**QUESTION FOUR**

Read the passage below about cooking with oils.

Cooking at high temperatures can damage oils. The more omega 3 fatty acids in the oil, the less suitable it is for cooking. The heat not only damages the fatty acids, but it can also change them into harmful substances. Hydrogenated oils are often used for cooking. Since these oils have already been “damaged” by chemical processing, they are less likely to be further damaged by heat. The oils that are higher in saturated fats are the most stable when heated. These include peanut oil and olive oil. The more fragile oils are best used at room temperature, like salad dressings.

To preserve the nutritious properties and the flavour of unrefined oils, try the “wet-sauté”. Pour around one-fourth of a cup of water in the stir-fry pan and heat just below boiling. Then add the food and cook it a little before adding the oil. Wet-sauté shortens the time oil is in contact with a hot pan. Stir frequently to further reduce the time the oil is in contact with the hot metal. Never heat oils to the smoking point, as this not only damages their fatty acid content but also their taste.

**4.1 Heating oils to smoking point . . .**

- A damages their fatty acid content.
- B is best for cooking chips.
- C is best for making salad oil.
- D turns them into margarine.

**4.2 Wet-sauté . . .**

- A damages oils.
- B is best for cooking chips.
- C is best for saturated oils.
- D is best for unsaturated oils.

**4.3** A hydrogenated oil . . .

- A** contains hydrogen.
- B** contains only carbon.
- C** has a better taste.
- D** is saturated.

**4.4** Hydrogenated oils have been ‘damaged’ by chemical processing.

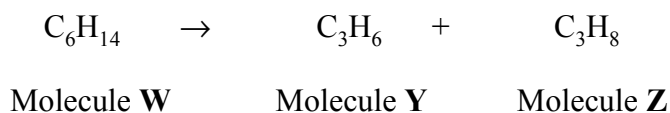
In this processing, . . .

- A** unsaturated oils are frozen to make them solid.
- B** unsaturated oils are gently heated with hydrogen in the presence of a catalyst.
- C** unsaturated oils are heated to a high temperature.
- D** vapour from unsaturated oils is passed over a hot catalyst.

**Turn over for the next question**

### QUESTION FIVE

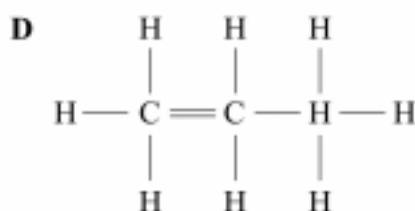
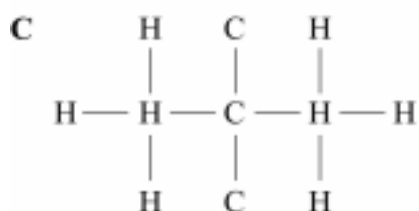
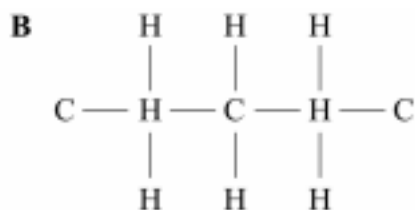
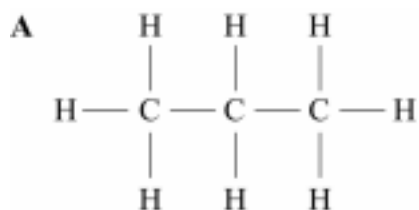
A molecule of a hydrocarbon, formula  $C_6H_{14}$ , can be cracked to produce two different hydrocarbons with smaller molecules.



5.1 The large hydrocarbon molecule can be cracked by . . .

- A distillation
- B polymerisation.
- C thermal decomposition.
- D vaporisation.

5.2 The structural formula for molecule **Z** is . . .





**5.3** Which of the three molecules, **W**, **Y** and **Z**, have double bonds?

- A** Molecules **W** and **Y**
- B** Molecules **W** and **Z**
- C** Molecule **W** only
- D** Molecule **Y** only

**5.4** What types of hydrocarbons are molecules **Y** and **Z**?

	<b>Molecule Y</b>	<b>Molecule Z</b>
<b>A</b>	saturated	saturated
<b>B</b>	saturated	unsaturated
<b>C</b>	unsaturated	saturated
<b>D</b>	unsaturated	unsaturated

**Turn over for the next question**

---

**QUESTION SIX**

Carbon is an essential part of all living things and it is often circulated in nature in carbon dioxide.

- 6.1** Carbon dioxide is removed from the atmosphere when it dissolves in sea water to form soluble . . .
- A** calcium carbonate.
  - B** calcium hydrogencarbonate.
  - C** carbohydrates.
  - D** hydrocarbons.
- 6.2** The amount of carbon dioxide in the atmosphere is also reduced by . . .
- A** the activity of plants.
  - B** the destruction of forests.
  - C** the eruptions of volcanoes.
  - D** the weathering of limestone.
- 6.3** Carbon dioxide is released into the atmosphere from volcanoes following the decomposition of . . .
- A** carbonate rocks.
  - B** igneous rocks.
  - C** metamorphic rocks.
  - D** sandstone rocks.
- 6.4** Recently, the balance between the amount of carbon dioxide released into the atmosphere and the amount used up has been disturbed.
- This is mainly because of . . .
- A** burning of increased amounts of fossil fuels.
  - B** increased volcanic activity.
  - C** planting of large areas of forests.
  - D** the operation of more nuclear power stations.

**QUESTION SEVEN**

The diagram shows the present positions of South America and Africa.  
The position of the boundary between the tectonic plates on which they lie is also drawn.



- 7.1 The patterns of rocks on the east coast of South America and the west coast of Africa are very similar.

This suggests that . . .

- A Africa and South America have been moving slowly towards each other.
  - B Africa and South America were once together and have been moving slowly away from each other.
  - C Africa has been slowly sliding beneath South America.
  - D South America has been slowly sliding beneath Africa.
- 7.2 Tectonic plates are constantly moving.

This movement is caused by . . .

- A convection currents.
- B the Earth's crust shrinking.
- C the gravitational attraction of the Sun.
- D the rotation of the Earth.

**7.3** The interior of the Earth remains hot because of . . .

- A** earthquakes.
- B** friction between the core and the mantle.
- C** friction between the moving plates.
- D** natural radioactive processes.

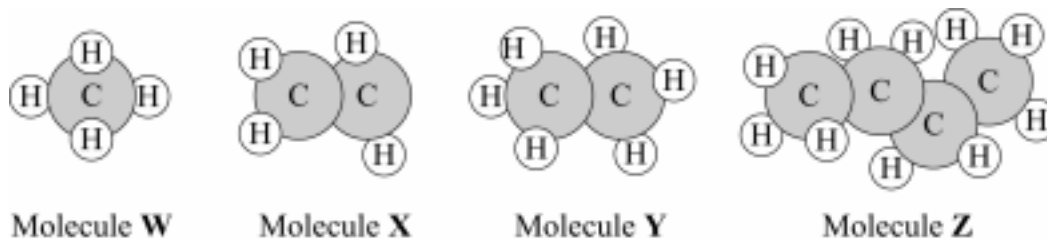
**7.4** The plates move with relative speeds of . . .

- A** a few centimetres a day.
- B** a few centimetres a week.
- C** a few centimetres a month.
- D** a few centimetres a year.

**Turn over for the next question**

**QUESTION EIGHT**

The drawings represent four different hydrocarbon molecules.



**8.1** Which molecule is unsaturated?

- A Molecule **W**
- B Molecule **X**
- C Molecule **Y**
- D Molecule **Z**

**8.2** Which of the following belong to the alkane family?

- A Molecules **X** and **Y**
- B Molecule **W** only
- C Molecules **W**, **X** and **Z**
- D Molecules **W**, **Y** and **Z**

**8.3** Molecules of **X** can be joined together to form a polymer.

What is the name of the polymer?

- A Poly(ethene)
- B Poly(vinyl chloride)
- C Poly(propene)
- D Poly(styrene)

**8.4** Molecules can also be represented by chemical formulae.

For example, molecule **W** has one carbon atom and four hydrogen atoms and is represented by the formula  $\text{CH}_4$

The chemical formula for molecule **Z** is. . .

- A**  $\text{C}_4\text{H}_8$
- B**  $\text{C}_{10}\text{H}_4$
- C**  $\text{C}_4\text{H}_{10}$
- D**  $\text{C}_4\text{H}_{12}$

**Turn over for the next question**

---

**QUESTION NINE**

Scientists used to believe that the Earth was cooling. The shrinking core was making the crust wrinkle.

In 1915, Alfred Wegener suggested that all the continents had once been joined together. Later, they had split up and the separate pieces had moved apart.

Few people believed Wegener's theory. Later, new evidence suggested that the crust was divided into plates which could move slowly. This gave support to Wegener's theory.

**9.1** How did scientists, who supported the idea that the Earth was cooling, explain the formation of mountains?

- A** Mountains rose up from the sea bed.
- B** Mountains were formed by volcanoes.
- C** The high points of wrinkles formed the mountains.
- D** The less dense rocks rose above those that were more dense.

**9.2** What name was given to Wegner's theory of crustal movement?

- A** Continental drift
- B** Continental shrinking
- C** Mountain building
- D** Subduction

**9.3** Scientists now believe that mountain ranges are formed . . .

- A** by earthquakes.
- B** by large-scale movements of the Earth's crust.
- C** by magma rising from the sea floor.
- D** by material from the fluid mantle being forced above the crust.



**9.4** New mountain ranges replace older mountain ranges which . . .

- A** are destroyed by earthquakes.
- B** are destroyed when tectonic plates come together.
- C** are worn down by weathering and erosion.
- D** sink back into the mantle.

**END OF TEST**

**GCSE SCIENCE A**  
**OBJECTIVE TEST ANSWER KEY**  
**UNIT CHEMISTRY 1b FOUNDATION TIER**

Question No.	KEY
One	1 – C 2 – D 3 – B 4 – A
Two	1 – C 2 – B 3 – A 4 – D
Three	1 – A 2 – C 3 – D 4 – B
Four	1 – A 2 – D 3 – B 4 – C
Five	1 – A 2 – B 3 – C 4 – D
Six	1 – C 2 – A 3 – B 4 – D
Seven	7.1 – A, 7.2 – C, 7.3 – D, 7.4 – A
Eight	8.1 – C 8.2 – C 8.3 – C 8.4 – B
Nine	9.1 – A 9.2 – D 9.3 – D 9.4 – B
<b>Overall marks = 36</b>	

**GCSE SCIENCE A**  
**OBJECTIVE TEST ANSWER KEY**

**UNIT CHEMISTRY 1b HIGHER TIER**

<b>Question No.</b>	<b>KEY</b>
One	1 – C 2 – A 3 – B 4 – D
Two	1 – B 2 – C 3 – D 4 – A
Three	3.1 – C, 3.2 – C, 3.3 – C, 3.4 – B
Four	4.1 – A, 4.2 – D, 4.3 – D, 4.4 – B
Five	5.1 – C, 5.2 – A, 5.3 – D, 5.4 – C
Six	6.1 – B, 6.2 – A, 6.3 – A, 6.4 – A
Seven	7.1 – B, 7.2 – A, 7.3 – D, 7.4 – D
Eight	8.1 – B, 8.2 – D, 8.3 – A, 8.4 – C
Nine	9.1 – C, 9.2 – A, 9.3 – B, 9.4 – C
	<b>Overall marks = 36</b>

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Surname		Other Names	
Centre Number		Candidate Number	
Candidate signature			

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General Certificate of Secondary Education  
Specimen Paper

**SCIENCE B**  
**Unit Chemistry 1**

**CHEMISTRY**  
**Unit Chemistry 1**

**Foundation Tier**

Date and Time

**F**



**For this paper you must have:**

- a ruler

You may use a calculator.

Time allowed: 45 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 45.
- 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.

**Advice**

- In all calculations, show clearly how you work out your answer.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3			
4			
Total (Column 1)		→	
Total (Column 2)		→	
TOTAL			
Examiner's Initials			

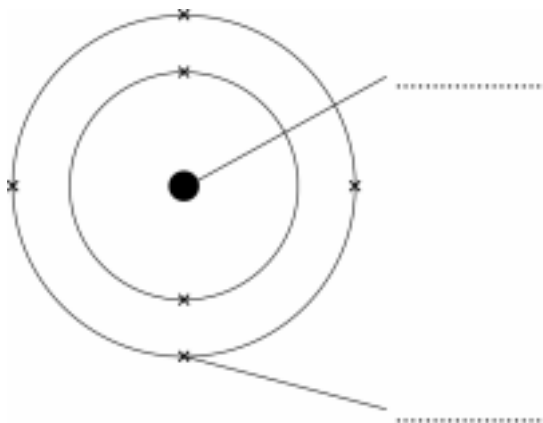
Answer **all** questions in the spaces provided.

- 1 (a) The diagram represents an atom.

Choose words from the box to label the diagram.

electrode	electron	ion	molecule	nucleus
-----------	----------	-----	----------	---------

(2 marks)



- (b) When atoms react to form compounds, they become joined by chemical bonds.

Complete the sentence about chemical bonds by crossing out the **two** incorrect words in the box.

When atoms form chemical bonds, it involves giving, taking or sharing

electrons
neutrons
protons

(1 mark)

2 Alloys have many important uses.

(a) State the meaning of the term *alloy*.

.....  
.....

(1 mark)

(b) This wedding ring is made from 18 carat gold. This is an alloy made from gold and silver.



The wedding ring has to last many years when worn every day.

Suggest and explain why the ring is made from an alloy rather than **pure** gold.

.....  
.....

(2 marks)

(c) The metal frame of these glasses is made from a *smart alloy*. This alloy is made from titanium and nickel.



Give **one** advantage of making the frame from a smart alloy, instead of an ordinary metal.

.....  
.....

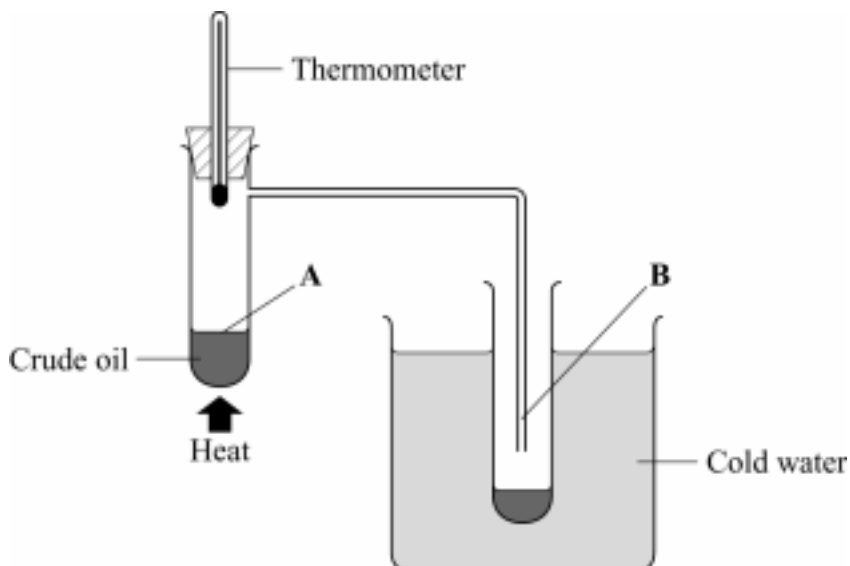
(1 mark)

- 3 (a) Complete this sentence about crude oil.

Crude oil is mainly a mixture of compounds called .....  
which contain carbon and hydrogen only.

(1 mark)

- (b) The diagram shows a laboratory experiment used to separate crude oil.



Complete each sentence by choosing the correct words from the box.

<b>condensation</b>	<b>distillation</b>	<b>evaporation</b>
<b>melting</b>	<b>sublimation</b>	

The main process taking place at **A** is .....

The main process taking place at **B** is.....

This method of separating crude oil is called .....  
(3 marks)

- (c) Complete this sentence by crossing out the word in each box that is wrong. The first one has been done for you.

This method of separating crude oil works because the smaller the molecules are,  
the higher their boiling point and the more volatile they are.  
~~larger~~

(1 mark)



(d) (i) The separation of crude oil produces lots of hydrocarbons with large molecules.

Choose a word from the box to complete the sentence.

<b>condensing</b>	<b>cracking</b>	<b>distilling</b>	<b>evaporating</b>
-------------------	-----------------	-------------------	--------------------

At an oil refinery, large hydrocarbons are broken down into smaller molecules by a process called .....  
(1 mark)

(ii) Some of the small molecules produced can be used to make polymers.

Name the polymer made from ethene.

.....  
(1 mark)

(e) Crisp packets are often made from a **non-biodegradable** polymer.

Suggest why this:

(i) is good for storing crisps

.....  
.....  
.....  
.....  
(2 marks)

(ii) could be bad for the environment.

.....  
.....  
(1 mark)

4 Limestone is a useful rock.

(a) Limestone can be used to make several useful products.

Draw rings around **two** useful products made from limestone.

**cement**

**diesel**

**glass**

**petrol**

**plastic**

(2 marks)

(b) A student did some experiments to study limestone.

In one experiment, a piece of limestone was heated very strongly as shown in the diagram.



(i) Suggest **one** safety precaution that the student should take when doing this experiment.

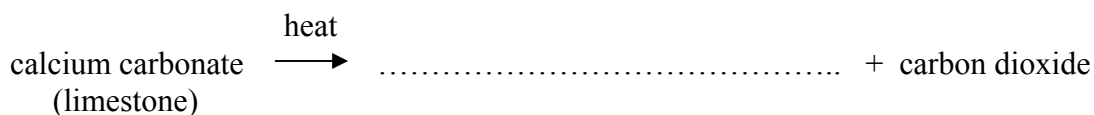
.....  
.....

(1 mark)

- (ii) When limestone is heated it forms two products; a white powder and a gas.

Complete the word equation by choosing the correct product from the list.

**calcium carbide    calcium hydroxide    calcium nitride    calcium oxide**



(1 mark)

- (c) The student did another experiment using 2.00 grams of limestone. The limestone was weighed before and after being heated. The student then repeated this experiment. A new sample of 2.00 grams of limestone was used.

The results are shown in the table.

	Experiment 1	Experiment 2
Mass of limestone before heating in grams (g)	2.00	2.00
Mass of limestone after heating in grams (g)	1.12	1.10
Mass lost in grams (g)	0.88	0.90

- (i) Calculate the average mass lost for the two experiments.

.....

Average mass lost = ..... g  
(1 mark)

- (ii) Explain why it was important for the student to repeat this experiment.

.....

.....  
(1 mark)

**Question 4 continues on the next page**

(iii) Suggest why the mass lost was not the same for the two experiments.

.....  
.....

*(1 mark)*

(iv) Explain why a balance which measures to the nearest 0.1 g would **not** be suitable for this experiment.

.....  
.....

*(1 mark)*

(v) Suggest what mass of carbon dioxide would be produced when 2.00 g of limestone is heated.

Mass of carbon dioxide produced = ..... g  
*(1 mark)*

(d) The drawing shows a limestone quarry.



(i) Suggest **two** ways in which the limestone quarry may harm the environment.

- 1 .....
- .....
- .....
- 2 .....
- .....

*(2 marks)*

(ii) Suggest **two** ways in which the limestone quarry is of benefit to people.

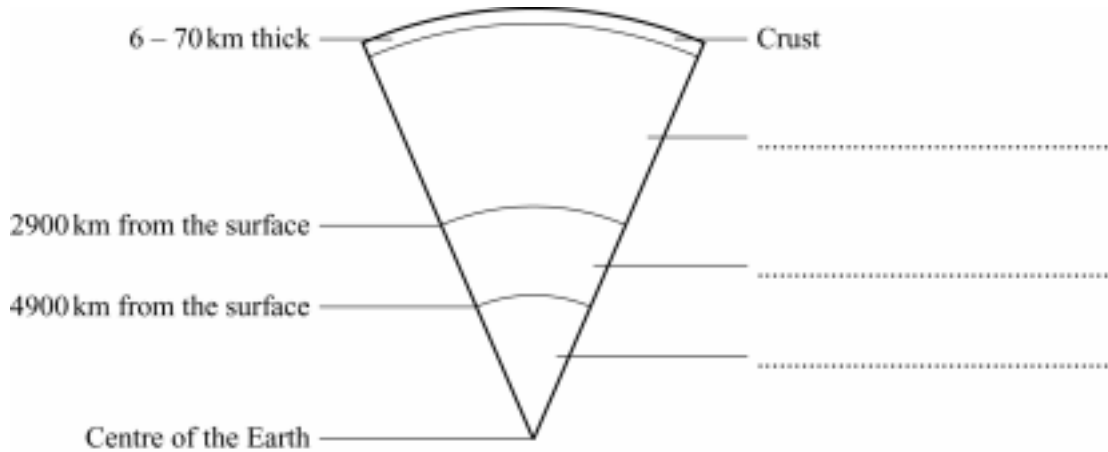
- 1 .....
- .....
- 2 .....
- .....

*(2 marks)*

**Turn over for the next question**

5 (a) The diagram shows the layered structure of the Earth.

Complete the diagram by adding the **three** missing labels.



(3 marks)

(b) The crust and upper mantle are cracked into a number of pieces called tectonic plates.

(i) Explain why these tectonic plates move.

.....

.....

.....

.....

(2 marks)

(ii) Explain why the movement of the tectonic plates can lead to major disasters.

.....

.....

.....

.....

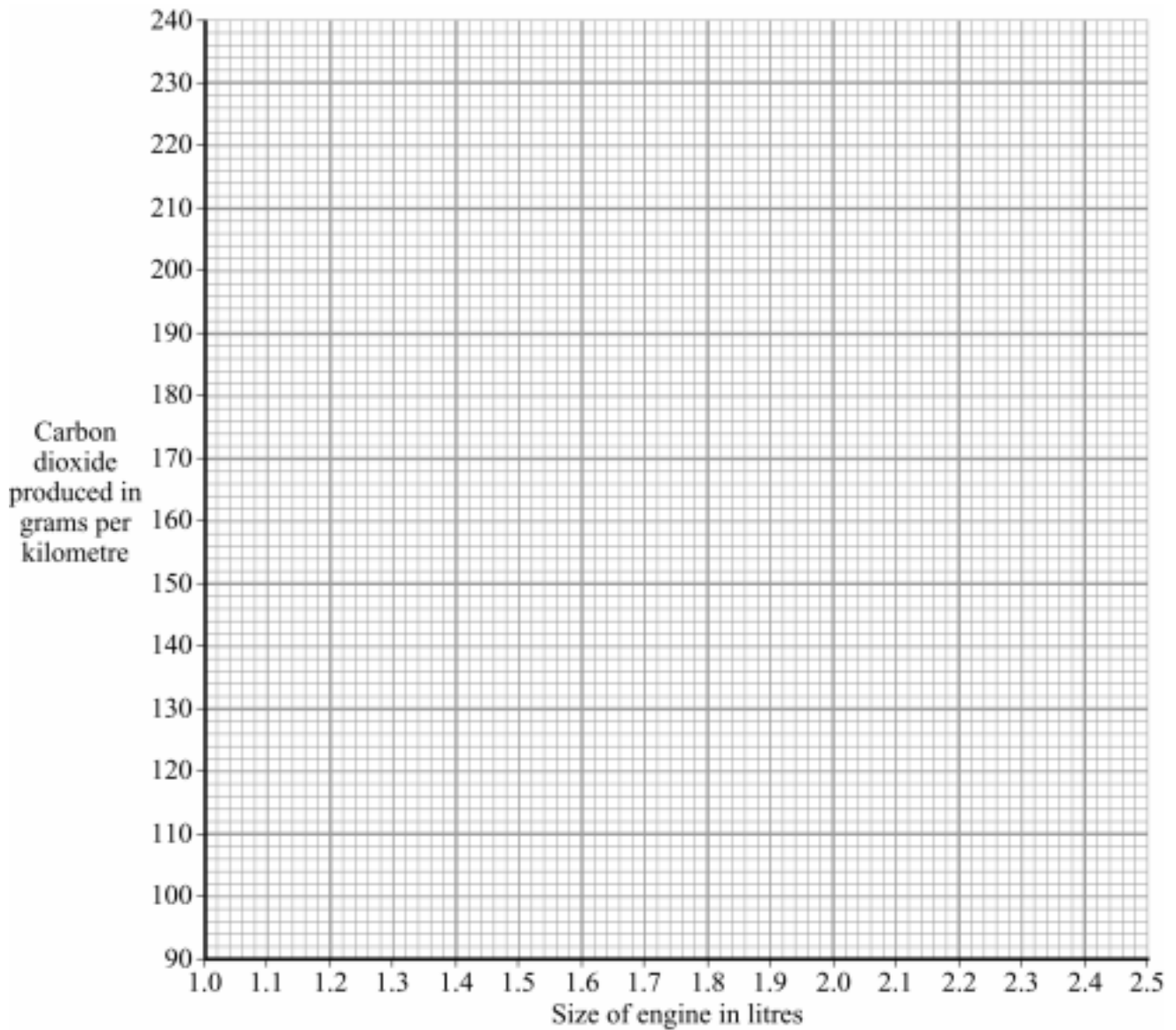
(2 marks)

**Turn over for the next question**

6 Most cars use either diesel or petrol as their fuel.

The table gives information about four cars of the same make and model but with different sized engines.

Size of engine (litres)	Fuel	Carbon dioxide produced (grams of carbon dioxide produced when the car travels one kilometre)
1.8	petrol	185
2.0	petrol	192
2.5	petrol	235
2.0	diesel	156





- (a) (i) Plot the **three** points for the **petrol** engines on the graph paper. (1 mark)
- (ii) Draw a straight line of best fit for the three points. (1 mark)
- (iii) Extend your line of best fit to estimate the mass of carbon dioxide per kilometre that might be produced by a 1.0 litre petrol engine.

Estimate of mass = ..... g/km  
(1 mark)

- (iv) A student made this conclusion from the data and graph.

*‘The larger the size of the petrol engine, the greater the mass of carbon dioxide that it produces per kilometre.’*

Is the data sufficient to be certain of this conclusion? Explain your answer.

.....  
 .....  
 .....  
 .....  
(2 marks)

- (b) The amount of carbon dioxide in the air is increasing. How might this affect the environment?

.....  
(1 mark)

- (c) This statement appeared in a magazine:

“Diesel engines cause less harm to the environment than petrol engines.”

Suggest **two** different sources of data you could use to test this statement.

1 .....  
 .....  
 2 .....  
 .....  
(2 marks)

**END OF QUESTIONS**

## Chemistry 1F Mark Scheme

### Question 1

	answers	extra information	mark
(a)	nucleus		1
	electron		1
(b)	electrons		1
<b>Total</b>			<b>3</b>

### Question 2

	answers	extra information	mark
(a)	mixture of metals (owtte)		1
(b)	pure gold is soft		1
	would wear quickly		1
(c)	returns to original shape when bent		1
<b>Total</b>			<b>4</b>

### Question 3

	answers	extra information	mark
(a)	hydrocarbons		1
(b)	evaporation		1
	condensation		1
	distillation		1
(c)	lower <b>and</b> more	<b>both</b> required for mark	1
(d)(i)	cracking		1
(ii)	poly(ethene) / polyethene / polythene / polyethylene		1
(e)(i)	polymer does not rot / decompose / not broken down by microorganisms	this can be awarded in part (i) or (ii) (but only once)	1
	idea of protecting crisps (could be stated in many ways) eg stops crisps from decomposing etc even prevent getting soggy etc		1
(ii)	litter / eyesore / harm to animals etc		1
<b>Total</b>			<b>10</b>

**Question 4**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	cement		1
	glass		1
(b)(i)	any <b>one</b> from: <ul style="list-style-type: none"><li>• wear safety goggles</li><li>• use mat under apparatus</li><li>• wear lab coat</li></ul>		1
(ii)	calcium oxide		1
(c)(i)	0.89 (g)		1
(ii)	to check accuracy etc		1
(iii)	experimental error or any other sensible answer		1
(iv)	not accurate enough or other sensible answers		1
(v)	0.89 (g)	accept 0.88 g / 0.90 g accept their average from (ii)	1

continued...

**Question 4 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(d)(i)	any <b>two</b> from: <ul style="list-style-type: none"><li>• dust</li><li>• noise</li><li>• eyesore</li><li>• pollution</li><li>• destroys habitats</li><li>• lorries along local roads</li></ul>	accept any sensible answer	2
(ii)	any <b>two</b> from: <ul style="list-style-type: none"><li>• makes useful products</li><li>• named useful products / uses (could get both marks here)</li><li>• building material / stone</li><li>• employment</li><li>• makes money</li></ul>		2
<b>Total</b>			<b>13</b>

**Question 5**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	mantle		1
	outer core		1
	inner core		1
(b)(i)	convection currents in the mantle		1
	driven by heat released by radioactive processes		1
(b)(ii)	any <b>two</b> from: plates may: <ul style="list-style-type: none"><li>• collide</li><li>• rub past each other</li></ul> movement may cause: <ul style="list-style-type: none"><li>• earthquakes</li><li>• volcanic eruptions</li></ul>		2
<b>Total</b>			<b>7</b>

### Question 6

	answers	extra information	mark
(a)(i)	accurately plotted points	$\pm \frac{1}{2}$ square	1
(ii)	sensible attempt at line of best fit	no very thick lines / curves / double lines / joining dots	1
(iii)	accurately read from their graph	$\pm \frac{1}{2}$ square	1
(iv)	no – 3 points / readings is not enough  <b>and any one</b> from:  <ul style="list-style-type: none"> <li>• to plot graph</li> <li>• to be certain of trend (owtte)</li> </ul> <b>or</b>  no – not a wide enough range (owtte)  <b>and any one</b> from:  <ul style="list-style-type: none"> <li>• to be certain of trend (owtte)</li> <li>• bigger smaller engines may not follow same trend</li> <li>• not a big enough difference between amount of CO<sub>2</sub> given out to be sure there is not a difference / could be experimental error</li> </ul>		1  1
(b)	global warming (owtte)		1

continued...

**Question 6 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(c)	Any <b>two</b> from: <ul style="list-style-type: none"><li>• own experiments</li><li>• text books</li><li>• scientific journals</li><li>• magazines</li><li>• newspapers</li><li>• internet</li><li>• oil companies / car manufacturers</li><li>• TV programmes</li><li>• CD rom encyclopaedia</li></ul>		2
<b>Total</b>			<b>8</b>
		<b>Overall marks</b>	<b>45</b>



Surname		Other Names	
Centre Number		Candidate Number	
Candidate signature			

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General Certificate of Secondary Education  
Specimen Paper

**SCIENCE B**  
**Unit Chemistry 1**

**CHEMISTRY**  
**Unit Chemistry 1**

**Higher Tier**

Date and Time

**H**



**For this paper you must have:**

- a ruler

You may use a calculator.

Time allowed: 45 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 45.
- 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.

**Advice**

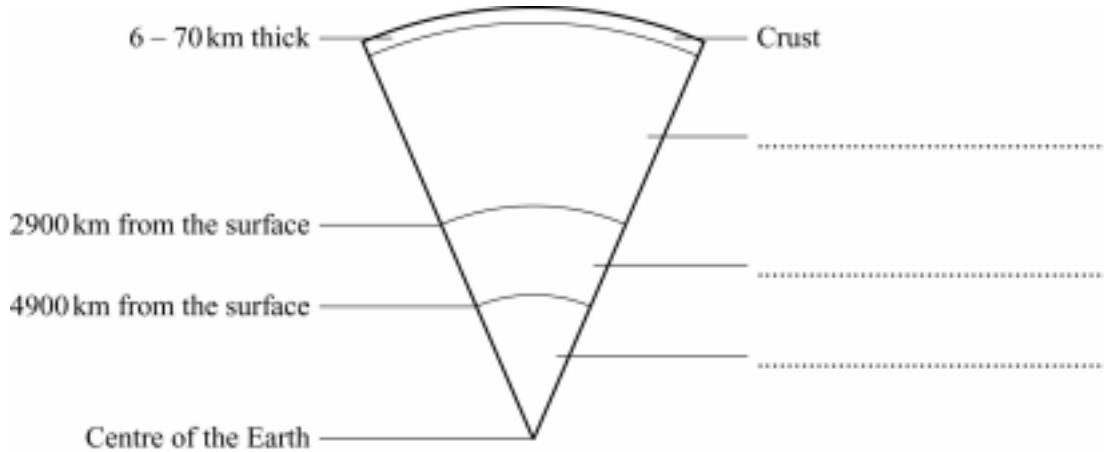
- In all calculations, show clearly how you work out your answer.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3			
4			
Total (Column 1)		→	
Total (Column 2)		→	
TOTAL			
Examiner's Initials			

Answer **all** questions in the spaces provided.

1 (a) The diagram shows the layered structure of the Earth.

Complete the diagram by adding the **three** missing labels.



(3 marks)

(b) The crust and upper mantle are cracked into a number of pieces called tectonic plates.

(i) Explain why these tectonic plates move.

.....

.....

.....

.....

(2 marks)

(ii) Explain why the movement of the tectonic plates can lead to major disasters.

.....

.....

.....

.....

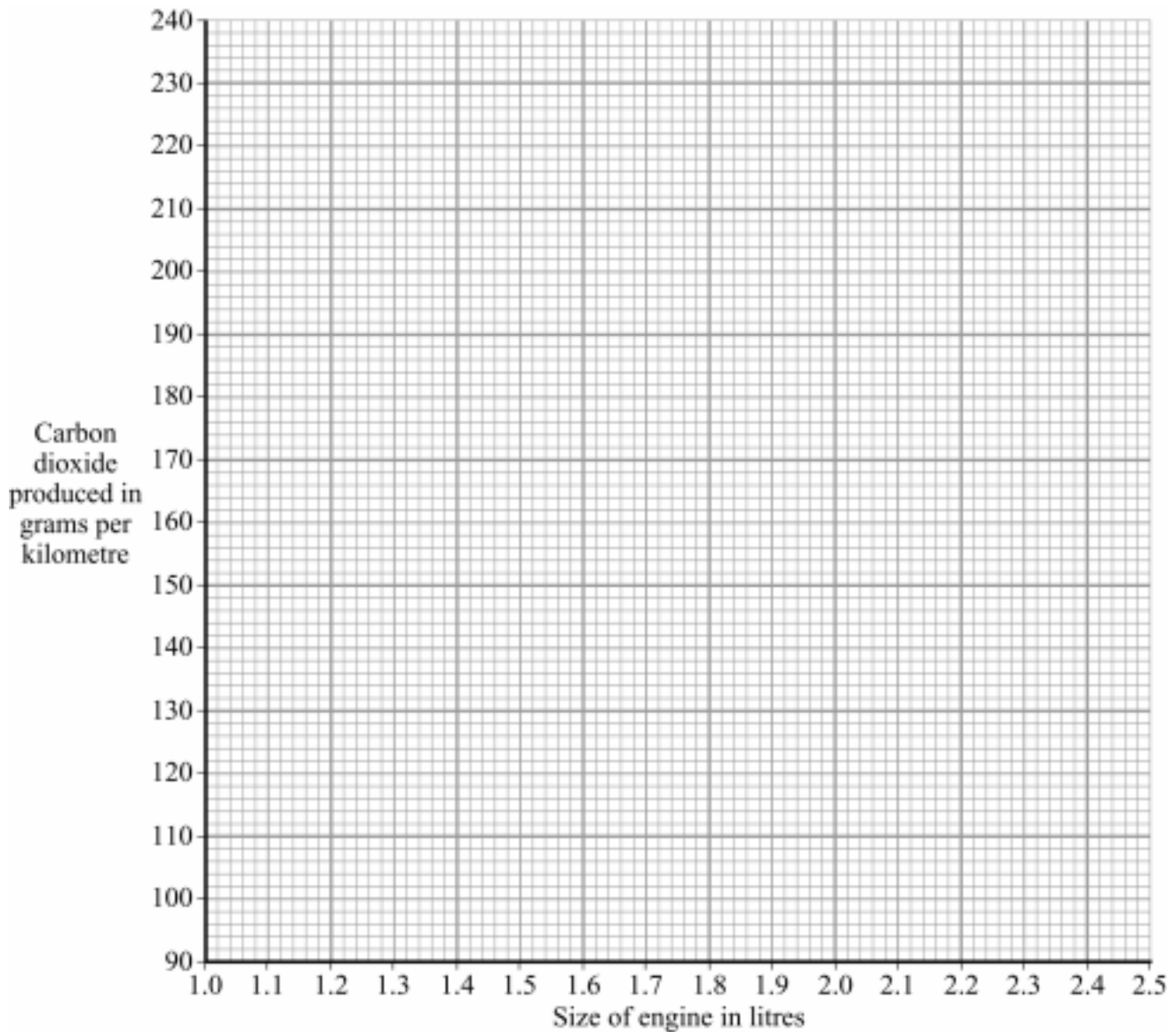
(2 marks)

**Turn over for the next question**

2 Most cars use either diesel or petrol as their fuel.

The table gives information about four cars of the same make and model but with different sized engines.

Size of engine (litres)	Fuel	Carbon dioxide produced (grams of carbon dioxide produced when the car travels one kilometre)
1.8	petrol	185
2.0	petrol	192
2.5	petrol	235
2.0	diesel	156



(a) (i) Plot the **three** points for the **petrol** engines on the graph paper. (1 mark)

(ii) Draw a straight line of best fit for the three points. (1 mark)

(iii) Extend your line of best fit to estimate the mass of carbon dioxide per kilometre that might be produced by a 1.0 litre petrol engine.

Estimate of mass = ..... g/km (1 mark)

(iv) A student made this conclusion from the data and graph.

*‘The larger the size of the petrol engine, the greater the mass of carbon dioxide that it produces per kilometre.’*

Is the data sufficient to be certain of this conclusion? Explain your answer.

.....  
.....  
.....  
.....  
.....  
(2 marks)

(b) The amount of carbon dioxide in the air is increasing. How might this affect the environment?  
.....  
(1 mark)

(c) This statement appeared in a magazine:  
“Diesel engines cause less harm to the environment than petrol engines.”  
Suggest **two** different sources of data you could use to test this statement.  
1 .....  
.....  
2 .....  
.....  
(2 marks)

- 3 This information was taken from a label on a packet of margarine.

<i>Ingredients</i>			
Vegetable oils; water; hydrogenated vegetable oils; salt; emulsifier; E471; Flavourings; Vitamin E; citric acid; E160a; Vitamins A and D			
<i>Nutritional information (per 100 g)</i>			
<b>Energy</b>	2775 kJ	<b>Fat</b>	75 g
<b>Protein</b>	nil	<b>saturated fat</b>	27 g
<b>Carbohydrate</b>	nil	<b>unsaturated fat</b>	48 g
<b>Fibre</b>	nil		
<b>Sodium</b>	0.94g		

- (a) Suggest why eating too much margarine could be bad for health.

.....  
 .....  
 (1 mark)

- (b) To harden margarine, some of the vegetable oils are hydrogenated.

How is vegetable oil hydrogenated?

.....  
 .....  
 .....  
 .....  
 .....  
 (2 marks)

- (c) The margarine contains some unsaturated fat.

- (i) What type of chemical bond is present in unsaturated fat that is not in saturated fat?

.....  
 (1 mark)

- (ii) To show that the margarine contains unsaturated fat it can be shaken with bromine water.

What change would be seen in the colour of the bromine water?

.....  
 (1 mark)

- 4 (a) A student did some experiments to study limestone.

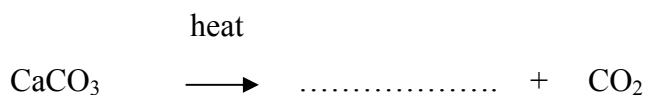
In one experiment, a piece of limestone was heated very strongly as shown in the diagram.



The limestone was converted into quicklime and carbon dioxide.



- (i) Complete the symbol equation for this reaction.



(1 mark)

- (ii) Give the chemical name for quicklime.

.....  
(1 mark)

**Question 4 continues on the next page**

- (b) A student did another experiment to measure the mass of quicklime formed when 2 grams of limestone was strongly heated.

The limestone was weighed before and after being heated, using a balance reading to the nearest gram.

The results are shown in the table.

Mass of limestone before heating in grams	2
Mass of quicklime formed in grams	1

- (i) What mass of carbon dioxide was produced? ..... g  
(1 mark)
- (ii) Suggest ways in which the student could improve the accuracy and reliability of the measurements.

.....

.....

.....

.....

.....

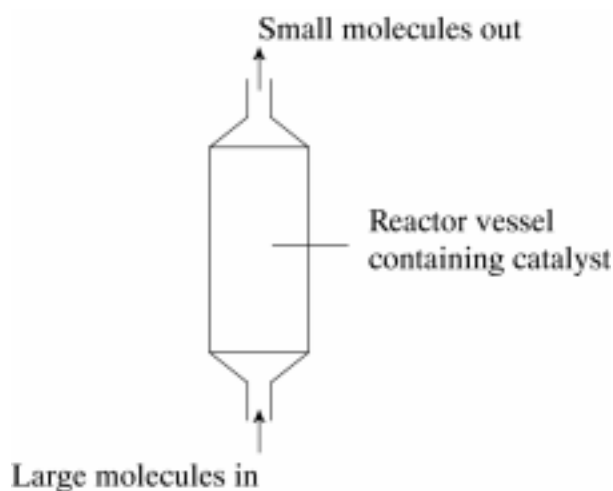
.....

(3 marks)

6
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- 5 Cracking is used in the oil industry to break large hydrocarbon molecules into smaller molecules.



- (a) Cracking involves a thermal decomposition reaction.

State what must be done to make a thermal decomposition take place.

.....  
(1 mark)

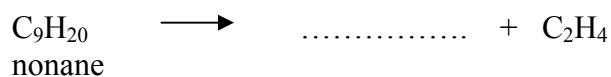
- (b) Suggest why air must be excluded from the reactor vessel.

.....  
.....  
(1 mark)

- (c) (i) The equation shows a reaction that can take place in the reactor vessel.

A nonane molecule is split into two smaller molecules.

Complete the equation by adding the formula of the other product.



(1 mark)

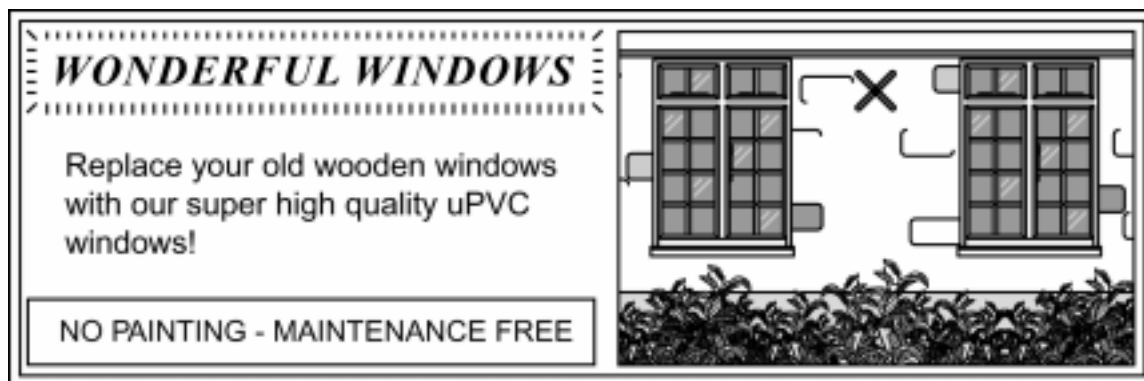
- (ii) The product with the formula  $\text{C}_2\text{H}_4$  is called ethene.  
Some ethene is reacted with steam. The equation represents this reaction.



Name the useful product with the formula  $\text{C}_2\text{H}_5\text{OH}$

.....  
(1 mark)

- (d) Modern window frames are often made from uPVC plastic which contains the *polymer* called poly(chloroethene).



- (i) State why plastic window frames need no painting or maintenance.

.....  
 .....

(1 mark)

- (ii) Name the monomer that is used to make poly(chloroethene).

.....  
 .....

(1 mark)

- (ii) Explain what is meant by the term *polymer*.

.....  
 .....  
 .....  
 .....

(2 marks)

- 6 Bridges are often made from steel.



- (a) Explain, in terms of atoms, why pure iron would be too soft for making bridges.

.....

.....

.....

.....

.....

.....

*(2 marks)*

- (b) The steel used for bridges is an alloy made from iron with a small amount of carbon.

Explain, in terms of atoms, how the addition of a small amount of carbon makes the steel suitable for bridges.

.....

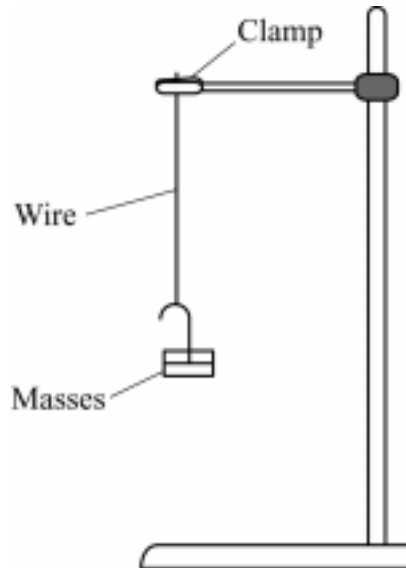
.....

.....

*(1 mark)*

- (c) The strength of a metal can be tested by measuring the force needed to snap a wire made from the metal. An apparatus that could be used is shown in the diagram.

Great care must be taken, since, when the wire snaps, the end of the wire could hit somebody.



The apparatus is used to compare the strength of two different metals.

Suggest **two** variables that must be controlled in order to make the experiment a fair test.

- 1 .....
- .....
- 2 .....
- .....

(2 marks)

(d) Read the information below about the recycling of steel and then answer the questions.

Scrap steel reduces related water pollution, air pollution, and mining wastes by about 70%. It takes four times as much energy to make steel from virgin ore.

Recycling steel and tin cans saves 74 % of the energy used to produce them from raw materials. At least 70–80 % of the tin on a can is saved when you recycle it. This cuts down mining waste and preserves a valuable ore source.

Every time a ton of steel is recycled, 2500 pounds of iron ore, 1000 pounds of coal and 40 pounds of limestone are preserved.

The recycling process involves simply melting the scrap steel and then removing impurities.

(i) Explain why mining iron ore causes environmental problems.

.....

.....

.....

.....

.....

.....

*(3 marks)*

**Question 6 continues on the next page**

(ii) Explain why as much steel as possible should be recycled.

.....

.....

.....

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.....

.....

*(3 marks)*

<hr/> <b>11</b>
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**END OF QUESTIONS**

## Chemistry 1H Mark Scheme

### Question 1

	answers	extra information	mark
(a)	mantle		1
	outer core		1
	inner core		1
(b)(i)	convection currents in the mantle		1
	driven by heat released by radioactive processes		1
(ii)	any <b>two</b> from: plates may: <ul style="list-style-type: none"><li>• collide</li><li>• rub past each other</li></ul> movement may cause: <ul style="list-style-type: none"><li>• earthquakes</li><li>• volcanic eruptions</li></ul>		2
<b>Total</b>			<b>7</b>

## Question 2

	answers	extra information	mark
(a)(i)	accurately plotted points	$\pm \frac{1}{2}$ square	1
(ii)	sensible attempt at line of best fit	no very thick lines / curves / double lines / joining dots	1
(iii)	accurately read from their graph	$\pm \frac{1}{2}$ square	1
(iv)	no – 3 points / readings is not enough  <b>and any one</b> from:  <ul style="list-style-type: none"> <li>• to plot graph</li> <li>• to be certain of trend (owtte)</li> </ul> <b>or</b>  no – not a wide enough range (owtte)  <b>and any one</b> from:  <ul style="list-style-type: none"> <li>• to be certain of trend (owtte)</li> <li>• bigger smaller engines may not follow same trend</li> <li>• not a big enough difference between amount of CO<sub>2</sub> given out to be sure there is not a difference / could be experimental error</li> </ul>		1  1
(b)	global warming (owtte)		1

continued...



**Question 2 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(c)	any <b>two</b> from: <ul style="list-style-type: none"><li>• own experiments</li><li>• text books</li><li>• scientific journals</li><li>• magazines</li><li>• newspapers</li><li>• internet</li><li>• oil companies / car manufacturers</li><li>• TV programmes</li><li>• CD rom encyclopaedia</li></ul>		2
<b>Total</b>			<b>8</b>

**Question 3**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	sensible ideas such as: obesity (owtte) heart problems (owtte)		1
(b)	addition of hydrogen and <b>one</b> from: <ul style="list-style-type: none"><li>• with nickel catalyst</li><li>• at 60°C</li></ul>		1 1
(c)(i)	double (carbon – carbon) bond		1
(ii)	turns colourless  do <b>not</b> accept clear		1
<b>Total</b>			<b>5</b>

**Question 4**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)(i)	CaO		1
(ii)	calcium oxide		1
(b)(i)	1 (g)		1
(ii)	use a more accurate balance		1
	repeat the experiment		1
	take an average of all the experiments		1
<b>Total</b>			<b>6</b>

**Question 5**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	heat		1
(b)	sensible ideas such as: so that the hydrocarbons do not burn /oxidise so that catalyst does not oxidise		1
(c)(i)	$C_7H_{16}$		1
(ii)	ethanol		1
(d)(i)	not biodegradable / do not rot etc		1
(ii)	chloroethene		1
(iii)	many small molecules joined to form a very large molecule		1 1
<b>Total</b>			<b>8</b>

### Question 6

	answers	extra information	mark
(a)	atoms arranged in layers		1
	which can slide over each other		1
(b)	different sized / carbon atoms in structure distort layers / so more difficult to slide over each other		1
(c)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• length of wire</li> <li>• diameter of wire (owtte)</li> <li>• temperature</li> </ul>		2
(d)(i)	any <b>three</b> from: <ul style="list-style-type: none"> <li>• destroy habitat</li> <li>• dust caused by the mining gives air pollution</li> <li>• noise from blasting / machines etc.</li> <li>• unsightly waste tips</li> <li>• scarred landscape (owtte)</li> <li>• waste / minerals etc. carried by rain into water supplies / rivers / lakes etc / causes water pollution</li> </ul>		3

continued...

**Question 6 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(ii)	any <b>three</b> from: <ul style="list-style-type: none"> <li>• cost of raw materials or named raw material / raw materials</li> <li>• produces waste slag</li> <li>• uses up raw materials / recycling means ores are conserved</li> <li>• less energy used</li> <li>• causes more pollution due to waste gases from burning fuels</li> <li>• blast furnace burns a large quantity of coke / energy needed for hot air blast</li> <li>• energy only needed to melt cans</li> </ul>		3
<b>Total</b>			<b>11</b>
		<b>Overall marks</b>	<b>45</b>

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Surname		Other Names	
Centre Number		Candidate Number	
Candidate signature			

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General Certificate of Secondary Education  
Specimen Paper

**ADDITIONAL SCIENCE**  
**Unit Chemistry 2**

**CHEMISTRY**  
**Unit Chemistry 2**

**Foundation Tier**

Date and time

**F**



<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a ruler</li> <li>• the data sheet (enclosed)</li> </ul> <p>You may use a calculator.</p>
---

Time allowed: 45 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 45.
- 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.

**Advice**

- In all calculations, show clearly how you work out your answer.

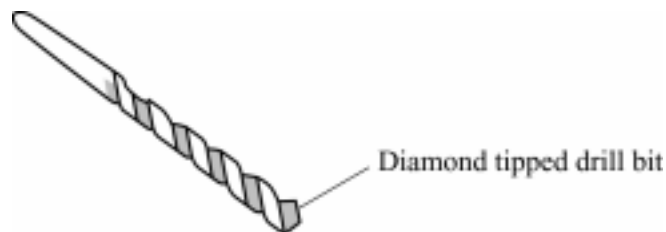
For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4			
Total (Column 1)		→	
Total (Column 2)		→	
<b>TOTAL</b>			
Examiner's Initials			

Answer **all** questions in the spaces provided.

1 Use words from the box to answer each of the questions.

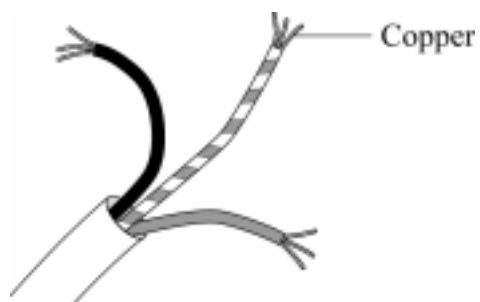
<b>ductile</b>	<b>electrons</b>	<b>hard</b>	<b>ions</b>	<b>layers</b>	<b>soft</b>
----------------	------------------	-------------	-------------	---------------	-------------

(a)



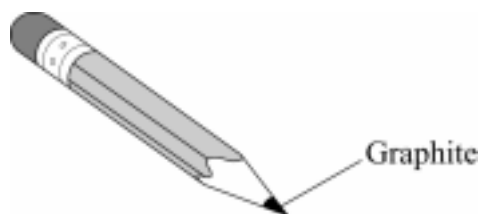
Diamond is used for cutting tools because it is ..... (1 mark)

(b)



Copper metal can be used for electrical wiring because it has delocalised ..... (1 mark)

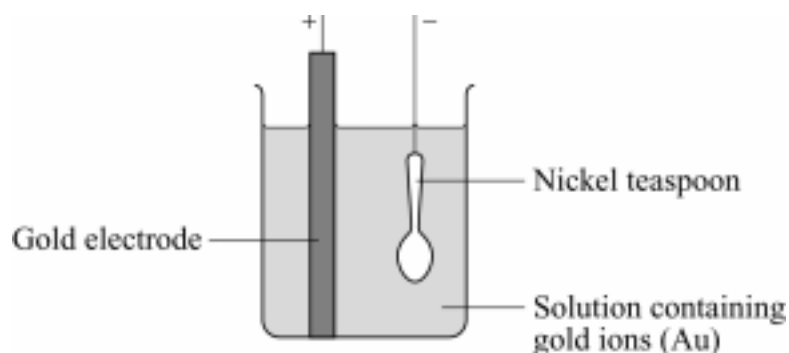
(c)



Graphite can be used in pencils because it has ..... which can slide over each other. (1 mark)



- 2 The diagram shows a method used to coat a nickel teaspoon with gold.



- (a) Draw a ring around the name of the process taking place.

**condensation**

**electrolysis**

**neutralisation**

**polymerisation**

(1 mark)

- (b) Why do gold ions move to the teaspoon?

.....  
.....

(1 mark)

- (c) Complete the sentence by crossing out the **two** words that are wrong in each box.

At the teaspoon, the gold ions change into gold atoms by 

gaining
losing
sharing

 an 

electron
neutron
proton

 .

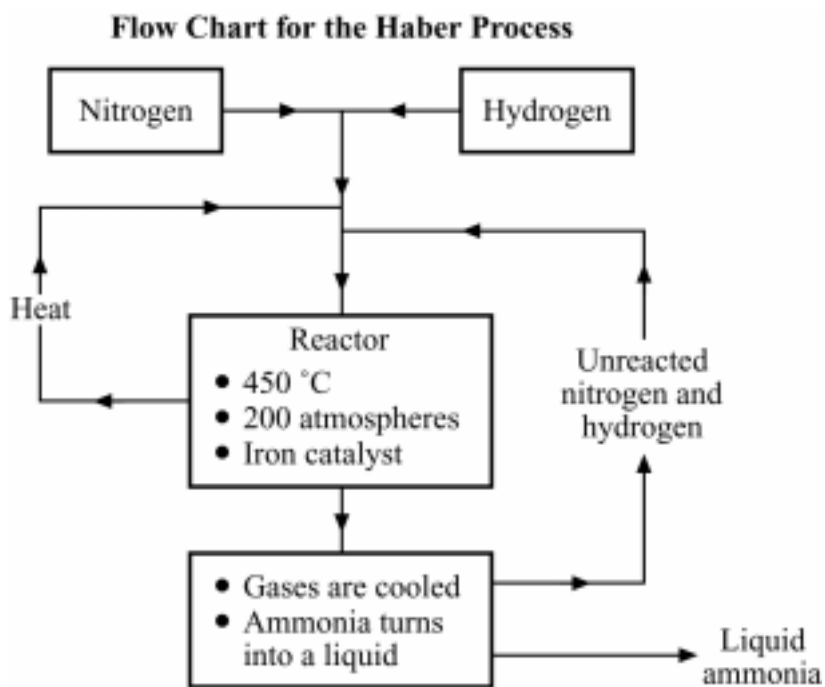
(2 marks)

- (d) Suggest why teaspoons are sometimes made by coating a thin layer of gold onto nickel instead of making the teaspoon from pure gold.

.....  
.....

(1 mark)

- 3 Ammonia is made in the Haber process from nitrogen and hydrogen.



Use the flow chart and your knowledge of the Haber process to help you to answer these questions.

- (a) Use words from the box to help you complete the sentence.

<b>air</b>	<b>iron</b>	<b>limestone</b>	<b>natural gas</b>	<b>platinum</b>
------------	-------------	------------------	--------------------	-----------------

In the Haber process, nitrogen from ..... is reacted with hydrogen from .....

The nitrogen and hydrogen are passed over a hot catalyst made of .....  
(3 marks)

- (b) How is the ammonia turned into a liquid?

.....  
(1 mark)

- (c) Use the flow chart to help you answer these questions.

Chemical factories must be very efficient in order to make a profit.

- (i) Give **three** ways in which this reaction is made to take place quickly.

- 1 .....
- 2 .....
- 3 .....

(3 marks)

- (ii) State how the best use is made of:

1. energy

- .....
- .....

(1 mark)

2. chemicals.

- .....
- .....

(1 mark)

- (d) Ammonia can be neutralised by an acid to form ammonium nitrate.

- (i) What type of substance is ammonia?

Draw a ring around the correct answer.

**acid**                      **alkali**                      **neutral**                      **salt**

(1 mark)

- (ii) Choose a word from the box to complete the equation for this reaction.

<b>ammonium</b>	<b>nitrate</b>	<b>nitric</b>	<b>nitrogen</b>
-----------------	----------------	---------------	-----------------

Ammonia + ..... acid → ammonium nitrate + water  
(1 mark)

(e) Read the information in the box and then answer the questions.

- When plants grow, they use up nitrogen compounds in the soil.
- For centuries, farmers used animal manure as a fertiliser.
- In 1800, the population of the UK was about 10 million people.
- The population of the UK today is about 60 million people.
- Vast quantities of ammonium nitrate can be produced by the chemical industry.
- Ammonium nitrate is an excellent fertiliser.

Explain why large quantities of ammonium nitrate fertiliser are used today.

.....

.....

.....

.....

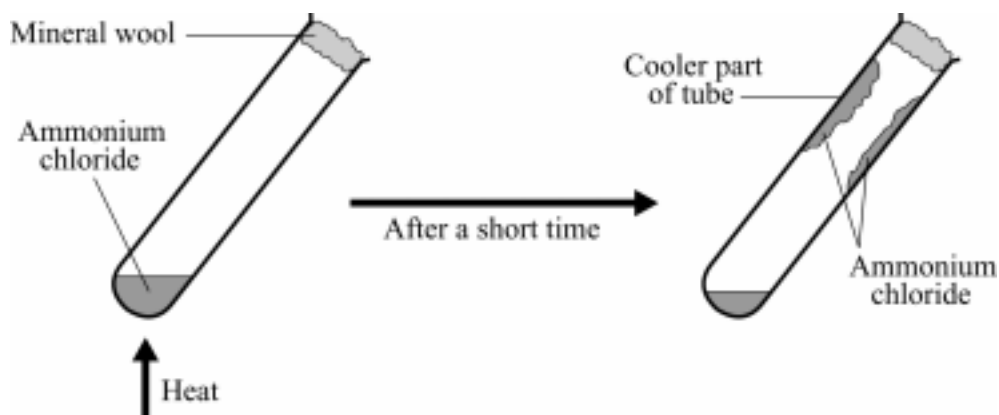
.....

.....

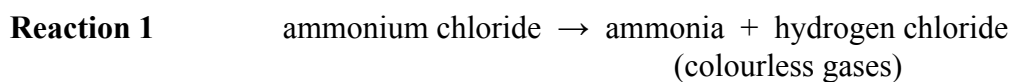
*(3 marks)*

4 A student did two experiments using ammonium chloride.

- (a) In the first experiment, the student heated a small amount of ammonium chloride in a test tube.



Two reactions take place in the test tube.



- (i) Complete the sentences by crossing out the incorrect word in each box.

**Reaction 1** takes place at a 

high
low

 temperature.

**Reaction 2** takes place at a 

high
low

 temperature.

(1 mark)

- (ii) Draw a ring around the word which best describes **Reactions 1** and **2**.

**combustion      displacement      oxidation      reduction      reversible**

(1 mark)

- (iii) Suggest a reason for the mineral wool at the top of the test tube.

.....  
.....

(1 mark)

- (b) In the second experiment, the student mixed a small amount of ammonium chloride with some water in a beaker.

The temperature of the water was measured before and after adding the ammonium chloride.

The results are shown in the table.

Temperature before adding the ammonium chloride	20 °C
Temperature after adding the ammonium chloride	16 °C

Draw a ring around the word which best describes the process which takes place.

**combustion**      **displacement**      **endothermic**      **exothermic**      **freezing**

*(1 mark)*

4
---

**Turn over for the next question**

5 Many foods contain chemical additives.

(a) A tin of creamed rice contains sodium carbonate as an acidity regulator.



Sodium carbonate is an ionic compound which contains sodium ions ( $\text{Na}^+$ ) and carbonate ions ( $\text{CO}_3^{2-}$ ).

Draw a ring around the formula of sodium carbonate.



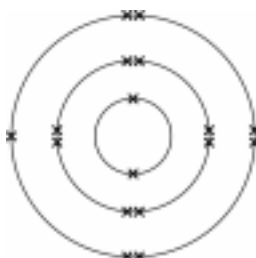
(1 mark)

(b) A tin of red kidney beans contains calcium chloride as a firming agent.



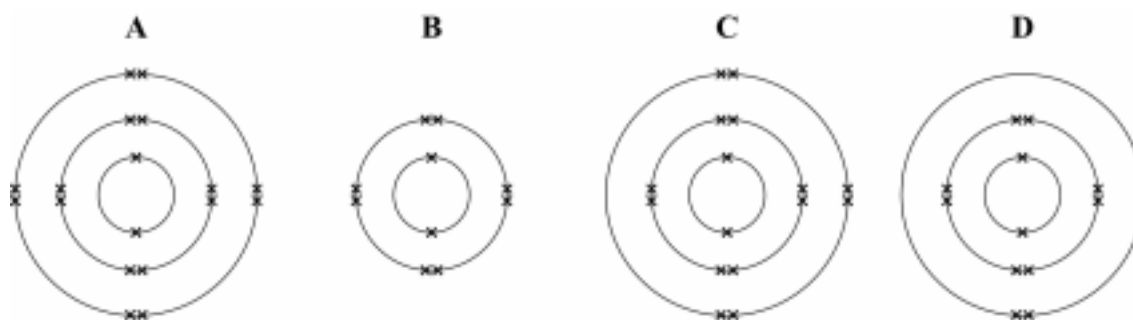
Calcium chloride contains calcium ions ( $\text{Ca}^{2+}$ ) and chloride ions ( $\text{Cl}^-$ ).

(i) The diagram represents the electronic structure of a chlorine atom.





Four electronic structures are shown in the box.



Which electronic structure, **A**, **B**, **C** or **D**, represents a chloride ion ( $\text{Cl}^-$ )?

.....  
(1 mark)

- (ii) Complete the following sentence by crossing out the **two** words that are incorrect in each box.

A calcium ion ( $\text{Ca}^{2+}$ ) is formed when a calcium atom

gains	two	electrons
loses		neutrons
shares		protons

(2 marks)

4

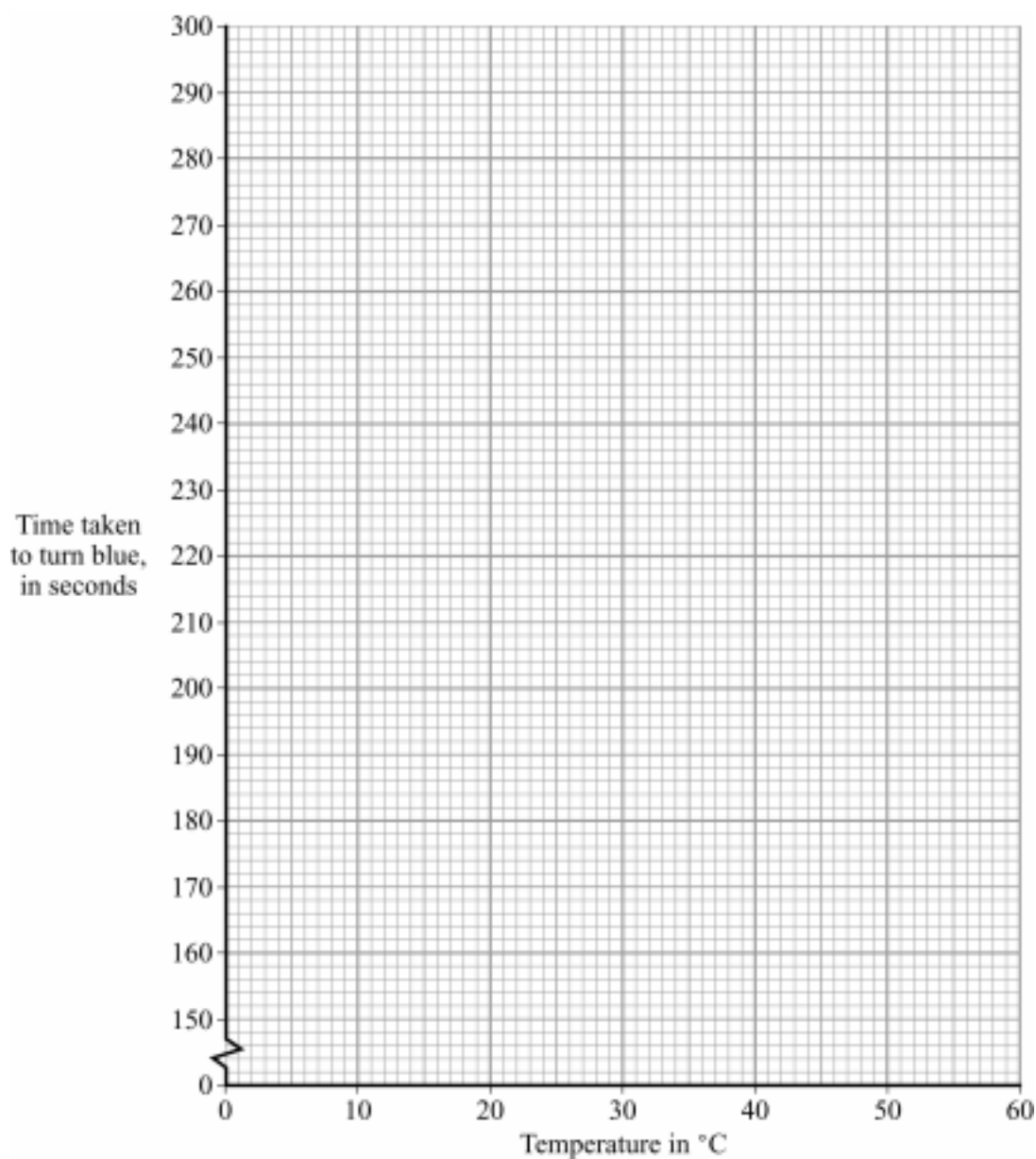
**Turn over for the next question**

- 6 Solutions **A** and **B** are colourless.  
When they are mixed, they react and turn blue after a period of time.  
A student investigated how temperature affected the rate of reaction between solutions **A** and **B**.  
The rate was measured by timing how long the mixture took to turn blue at different temperatures.

The results are shown in the table.

<b>Temperature in °C</b>	22	25	30	34	45	51
<b>Time taken to turn blue, in seconds</b>	290	250	238	200	170	160

- (a) (i) Draw a graph for these results with a line of best fit.



(2 marks)

(ii) Use your graph to find out how long it takes the solution to turn blue at 40°C.

Time = ..... s  
(1 mark)

(b) One of the results is anomalous.

(i) Complete this sentence.

The result at ..... °C is anomalous.  
(1 mark)

(ii) Suggest **two** possible causes of this anomalous result.

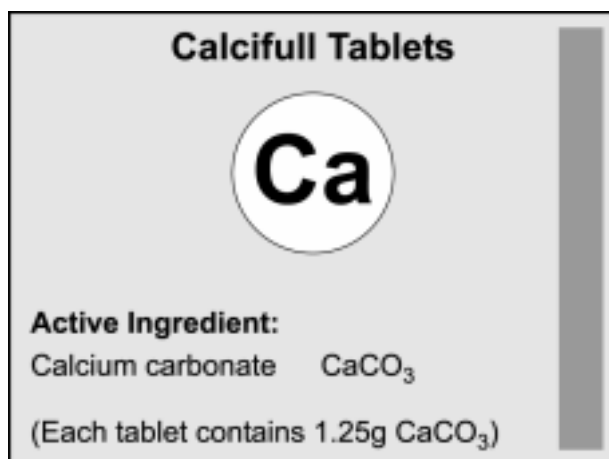
1 .....  
.....  
2 .....  
.....  
(2 marks)

(c) Explain, in terms of particles, why increasing the temperature increases the rate of reaction.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
(3 marks)

**Turn over for the next question**

- 7 Calcium carbonate tablets are used to treat people with calcium deficiency.



- (a) Calculate the relative formula mass ( $M_r$ ) of calcium carbonate.

Relative atomic masses: C = 12; O = 16; Ca = 40.

.....  
 .....

Relative formula mass = .....  
 (2 marks)

- (b) Calculate the percentage of calcium in calcium carbonate ( $\text{CaCO}_3$ ).

.....  
 .....

Percentage of calcium = ..... %  
 (2 marks)

- (c) Calculate the mass of calcium in each tablet.

.....  
 .....

Mass of calcium = ..... g  
 (1 mark)

- (d) An unwanted side effect of this medicine is that it can cause the patient to have 'wind' (too much gas in the intestine).

The equation below represents the reaction between calcium carbonate and hydrochloric acid (the acid present in the stomach).



Suggest why the patient may suffer from 'wind'.

.....  
.....

(1 mark)

6
---

**END OF QUESTIONS**

## Chemistry 2F Mark Scheme

### Question 1

	answers	extra information	mark
(a)	hard		1
(b)	electrons		1
(c)	layers		1
<b>Total</b>			<b>3</b>

### Question 2

	answers	extra information	mark
(a)	electrolysis		1
(b)	any <b>one</b> from: <ul style="list-style-type: none"><li>• gold ions are positive and spoon is negative</li><li>• opposite charges <b>attract</b> / gold ions are <b>attracted</b> to spoon</li><li>• positive ions move to negative electrode</li></ul>		1
(c)	gaining electron		1 1
(d)	pure gold is very expensive / cheaper to make from nickel with thin coat of gold etc		1
<b>Total</b>			<b>5</b>

### Question 3

	answers	extra information	mark
(a)	air		1
	natural gas		1
	iron		1
(b)	it is cooled		1
(c)(i)	high temperature / 450°C		1
	high pressure / 200 atmospheres		1
	catalyst used		1
(ii)	1. energy – heat is fed back to heat incoming gases (owtte)	accept heat is recycled	1
	2. raw materials	unreacted nitrogen and hydrogen are recycled	1
(d)(i)	alkali		1
(ii)	nitric		1
(e)	any <b>three</b> from: <ul style="list-style-type: none"> <li>• big increase in population so need more food</li> <li>• to grow more food need to replace nitrogen compounds in soil</li> <li>• not enough animal manure</li> <li>• large quantities of ammonium nitrate can be produced so farmers can grow more crops</li> </ul>		3
<b>Total</b>			<b>14</b>

**Question 4**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)(i)	high <b>and</b> low	<b>both</b> required for mark	1
(ii)	reversible		1
(iii)	to stop material spitting out (owtte)		1
(b)	endothermic		1
<b>Total</b>			<b>4</b>

**Question 5**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	$\text{Na}_2\text{CO}_3$		1
(b)(i)	<b>A</b>		1
(ii)	loses electrons		1 1
<b>Total</b>			<b>4</b>



### Question 6

	answers	extra information	mark
(a)(i)	plotting points accurately	$\pm \frac{1}{2}$ square	1
	sensible smooth curve	must not join dots	1
(ii)	as read from their graph	$\pm \frac{1}{2}$ square	1
(b)(i)	30 (°C)		1
(ii)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• eg error in timing</li> <li>• temperature not exactly measured</li> <li>• different amounts of reagents</li> <li>• different concentrations of <b>A</b> and <b>B</b></li> <li>• any other sensible reason</li> </ul>		2
(c)	any <b>three</b> from: <ul style="list-style-type: none"> <li>• particles gain energy</li> <li>• move faster</li> <li>• collide more often</li> <li>• collide with more force / energy / harder / more successful collisions / more collisions with activation energy</li> </ul>		3
<b>Total</b>			<b>9</b>

**Question 7**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	$40 + 12 + (3 \times 16)$ $= 100$	gains <b>1</b> mark gains <b>2</b> marks	<b>2</b>
(b)	$40 / 100 \times 100$ $= 40(\%)$	gains <b>1</b> mark ecf allowed from (a) for <b>2</b> marks	<b>2</b>
(c)	0.5(g)	ecf allowed from (b)	<b>1</b>
(d)	carbon dioxide produced		<b>1</b>
<b>Total</b>			<b>6</b>
		<b>Overall marks</b>	<b>45</b>

Surname		Other Names	
Centre Number		Candidate Number	
Candidate signature			

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General Certificate of Secondary Education  
Specimen Paper

**ADDITIONAL SCIENCE**  
**Unit Chemistry 2**

**CHEMISTRY**  
**Unit Chemistry 2**

**Higher Tier**

Date and time

**H**



<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a ruler</li> <li>• the data sheet (enclosed)</li> </ul> <p>You may use a calculator.</p>
---

Time allowed: 45 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 45.
- 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.

**Advice**

- In all calculations, show clearly how you work out your answer.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3			
4			
Total (Column 1)		→	
Total (Column 2)		→	
<b>TOTAL</b>			
Examiner's Initials			

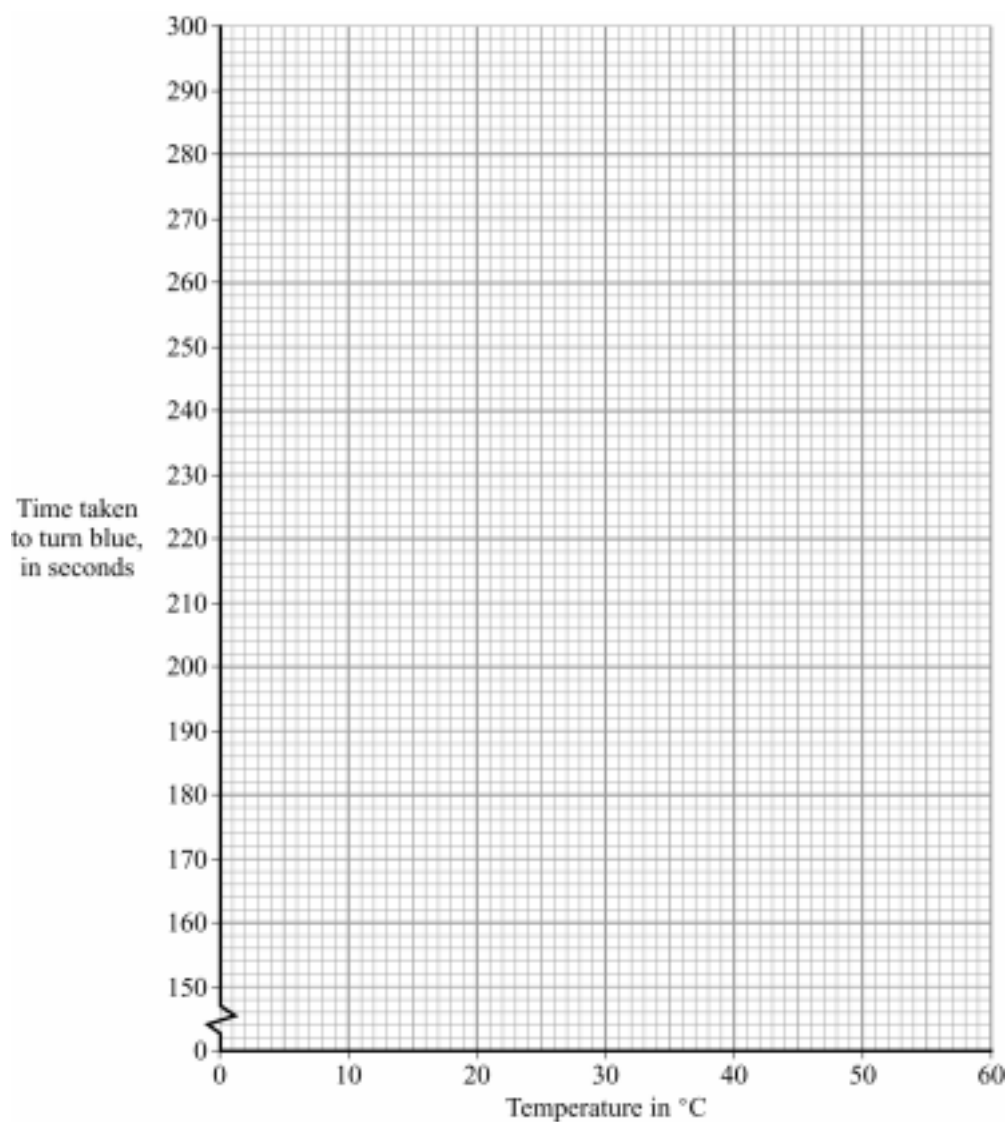
Answer **all** questions in the spaces provided.

- 1** Solutions **A** and **B** are colourless.  
When they are mixed, they react and turn blue after a period of time.  
A student investigated how temperature affected the rate of reaction between solutions **A** and **B**.  
The rate was measured by timing how long the mixture took to turn blue at different temperatures.

The results are shown in this table.

<b>Temperature in °C</b>	22	25	30	34	45	51
<b>Time taken to turn blue, in seconds</b>	290	250	238	200	170	160

- (a) (i) Draw a graph for these results with a line of best fit.



(2 marks)

(ii) Use your graph to find out how long it takes the solution to turn blue at 40°C.

Time = ..... s  
(1 mark)

(b) One of the results is anomalous.

(i) Complete this sentence.

The result at ..... °C is anomalous.  
(1 mark)

(ii) Suggest **two** possible causes of this anomalous result.

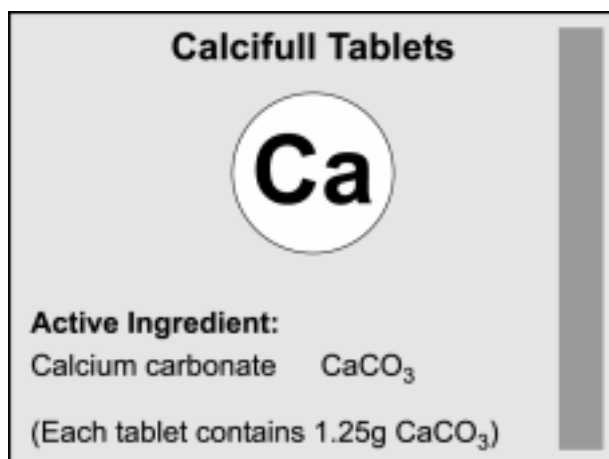
1 .....  
.....  
2 .....  
.....  
(2 marks)

(c) Explain, in terms of particles, why increasing the temperature increases the rate of reaction.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
(3 marks)

**Turn over for the next question**

- 2 Calcium carbonate tablets are used to treat people with calcium deficiency.



- (a) Calculate the relative formula mass ( $M_r$ ) of calcium carbonate.

Relative atomic masses: C = 12; O = 16; Ca = 40.

.....  
 .....

Relative formula mass = .....  
 (2 marks)

- (b) Calculate the percentage of calcium in calcium carbonate ( $\text{CaCO}_3$ ).

.....  
 .....

Percentage of calcium = ..... %  
 (2 marks)

- (c) Calculate the mass of calcium in each tablet.

.....  
 .....

Mass of calcium = ..... g  
 (1 mark)

- (d) An unwanted side effect of this medicine is that it can cause the patient to have 'wind' (too much gas in the intestine).

The equation below represents the reaction between calcium carbonate and hydrochloric acid (the acid present in the stomach).



Suggest why the patient may suffer from 'wind'.

.....  
.....

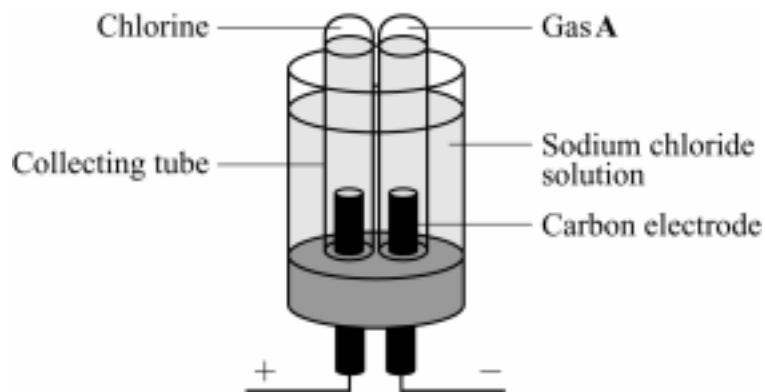
(1 mark)

6
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**Turn over for the next question**

- 3 The electrolysis of sodium chloride solution is an important industrial process. It produces three useful products.

The apparatus in the diagram can be used to show this electrolysis in the laboratory.



- (a) Name Gas A. .... (1 mark)

- (b) Chloride ions move to the positive electrode. Explain why.

.....  
 ..... (1 mark)

- (c) The solution around the negative electrode becomes alkaline.

Name the ion which makes the solution alkaline.

..... (1 mark)

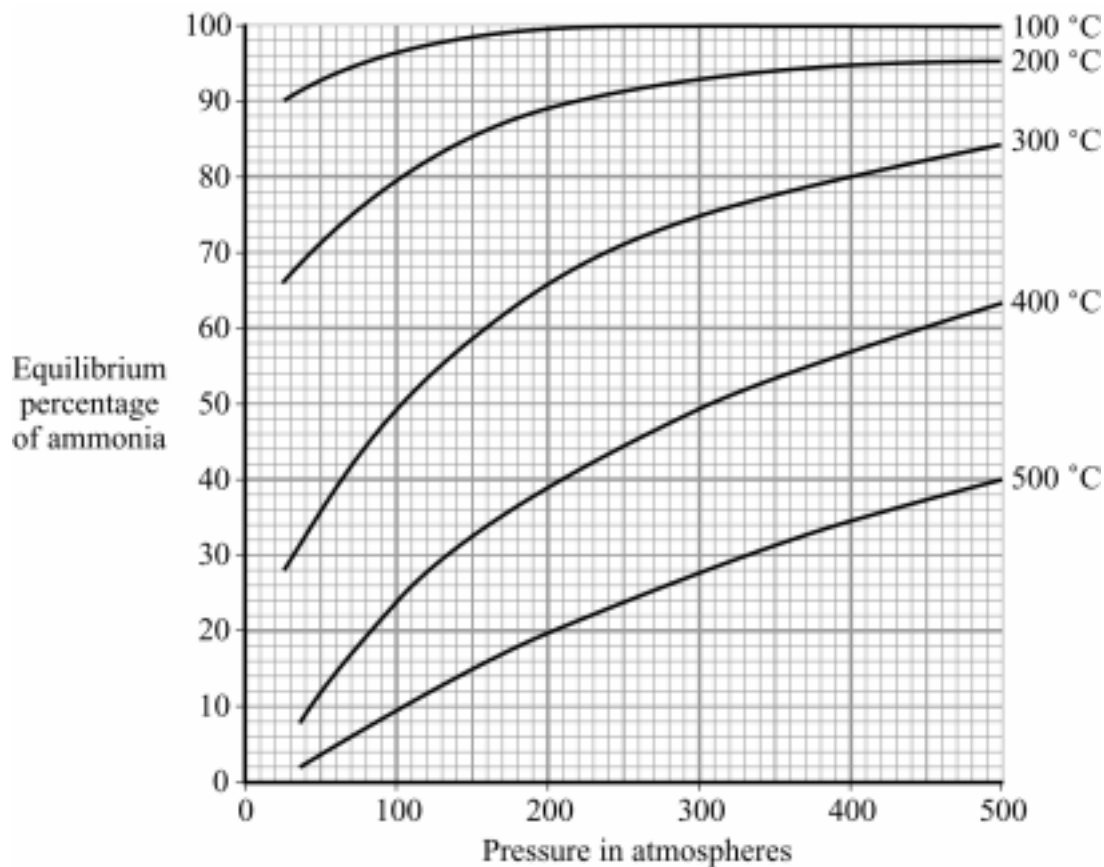
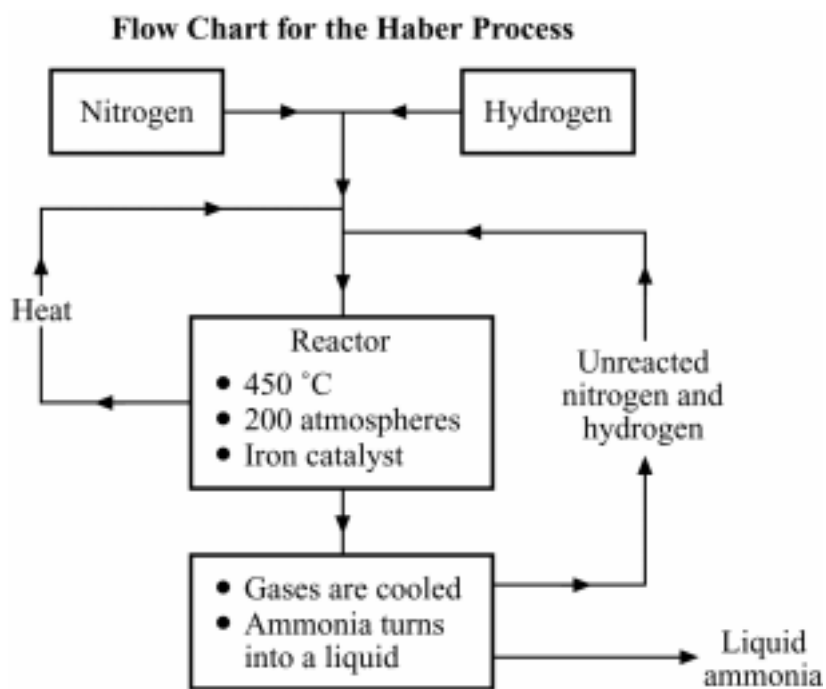
- (d) This process has very high energy costs. Explain why.

.....  
 ..... (1 mark)



**Turn over for the next question**

4 Ammonia is made from nitrogen and hydrogen in the Haber process.



- (a) Use information from the page opposite and your knowledge of the Haber process and reversible reactions to help you answer these questions.

State which conditions of temperature and pressure would give the highest percentage of ammonia at equilibrium. Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

.....

*(4 marks)*

- (b) The conditions of temperature and pressure which give the maximum yield at equilibrium are **not** used in industry. Suggest why.

.....

.....

.....

.....

*(2 marks)*

- (c) (i) Look carefully at the flow chart and suggest how the process makes the best use of energy and materials.

.....

.....

.....

.....

*(2 marks)*

**Question 4 continues on the next page**

(ii) Suggest why it is important to make the best possible use of energy and materials.

.....

.....

.....

.....

*(2 marks)*

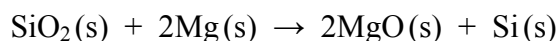
<hr/> <b>10</b>
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**Turn over for the next question**

5 Silicon is an important element used in the electronics industry.

- (a) Silicon can be made by heating a mixture of sand (silicon dioxide) with magnesium powder.

The equation for this reaction is shown below.



Calculate the mass of silicon dioxide needed to make 1 g of silicon.

Relative atomic masses: O = 16; Si = 28

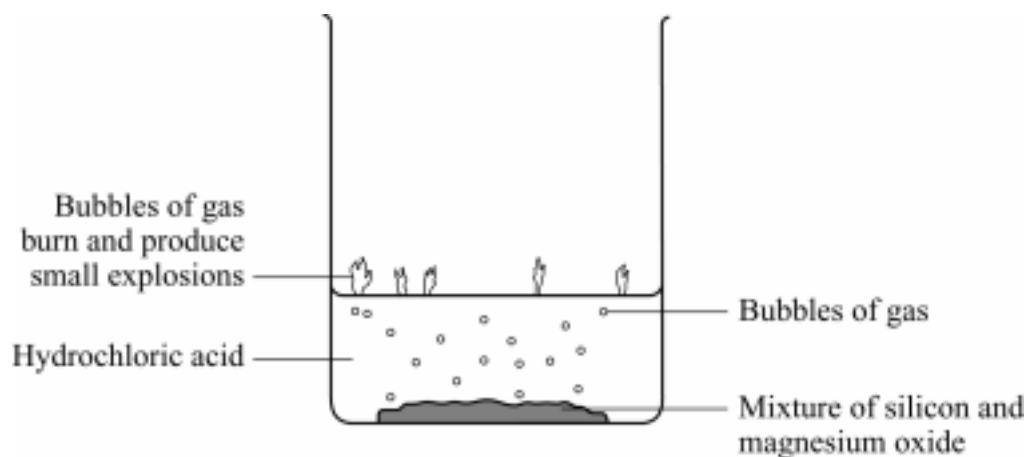
.....

.....

.....

Mass = ..... g  
(3 marks)

- (b) The resulting mixture of magnesium oxide and silicon is added to a beaker containing hydrochloric acid. The silicon is then filtered from the solution.



- (i) The magnesium oxide reacts with the hydrochloric acid and forms magnesium chloride ( $\text{MgCl}_2$ ) solution and water.

magnesium oxide + hydrochloric acid  $\rightarrow$  magnesium chloride solution + water

Write a balanced symbol equation for this reaction, including state symbols.

.....  
(2 marks)

- (ii) The gases produced are a mixture of several silicon hydrides.

One of the gases produced in the reaction is the silicon hydride with the formula  $\text{SiH}_4$ . The structure of this molecule is similar to methane,  $\text{CH}_4$ .

Draw a diagram to show the bonding in a molecule of  $\text{SiH}_4$ . Represent the electrons as dots and crosses and show the outer shell (energy level) electrons.

(1 mark)

(c) When this experiment was attempted, only 0.95 g of silicon was obtained instead of the 1 g that had been predicted.

(i) Calculate the percentage yield of silicon in this experiment.

.....  
.....

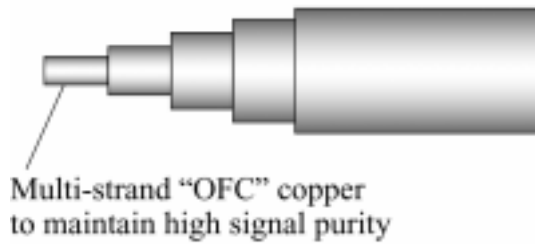
Percentage yield of silicon = ..... %  
(1 mark)

(ii) Suggest **one** reason for the yield being less than 100%.

.....  
.....

(1 mark)

- 6 The drawing shows a high quality wire used to make electrical connections on a hi-fi system.



- (a) Copper is used because it is a very good conductor of electricity. Copper is a typical metal.
- (i) Describe the structure and bonding in a metal. You may wish to draw a diagram to help you answer this question.

.....

.....

.....

.....

.....

(3 marks)

- (ii) Explain, by reference to your answer to part (a)(i), why copper conducts electricity.

.....

.....

(1 mark)



(iii) Explain, by reference to your answer to part (a)(i), why copper can be drawn into wires.

.....  
.....

(1 mark)

(b) The copper used to make this wire is “OFC” copper. This stands for ‘oxygen free copper’.

(i) It is thought that when molten copper is cooled and solidified, it can take in some oxygen from the air. This may slightly decrease the conductivity of the copper.

Suggest why the conductivity might be decreased.

.....  
.....  
.....  
.....  
.....

(2 marks)

(ii) To make it oxygen free, the copper is heated in an atmosphere of hydrogen.

Explain how this will remove the oxygen.

.....  
.....

(1 mark)

8
---

**END OF QUESTIONS**

## Chemistry 2H Mark Scheme

### Question 1

	answers	extra information	mark
(a)(i)	plotting points accurately	$\pm \frac{1}{2}$ square	1
	sensible smooth curve	must not join dots	1
(ii)	as read from their graph	$\pm \frac{1}{2}$ square	1
(b)(i)	30(°C)		1
(ii)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• eg error in timing</li> <li>• temperature not exactly measured</li> <li>• different amounts of reagents</li> <li>• different concentrations of <b>A</b> and <b>B</b></li> <li>• any other sensible reason</li> </ul>		2
(c)	any <b>three</b> from: <ul style="list-style-type: none"> <li>• particles gain energy</li> <li>• move faster</li> <li>• collide more often</li> <li>• collide with more force / energy / harder / more successful collisions / more collisions with activation energy.</li> </ul>		3
<b>Total</b>			<b>9</b>

**Question 2**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	$40 + 12 + (3 \times 16)$ $= 100$	gains <b>1</b> mark gains <b>2</b> marks	2
(b)	$40 / 100 \times 100$ $= 40 (\%)$	gains <b>1</b> mark ecf allowed from (a) for <b>2</b> marks	2
(c)	0.5 (g)	ecf allowed from (b)	1
(d)	carbon dioxide produced		1
<b>Total</b>			<b>6</b>

**Question 3**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	hydrogen		1
(b)	they have a negative charge	accept opposite charges attract etc	1
(c)	hydroxide		1
(d)	cost of electricity		1
<b>Total</b>			<b>4</b>

### Question 4

	answers	extra information	mark
(a)	low / lower / lowest temperature (or 100 °C from graph)	2 marks for comments related to temperature	1
	any <b>one</b> from:	ignore reference to catalyst	1
	<ul style="list-style-type: none"> <li>(forward) reaction exothermic</li> <li>if the temperature is increased the yield of product will decrease or reaction right to left</li> </ul>	2 marks for comments relating to pressure	1
	high / higher / highest pressure (or greater than 450 atm, from graph)		1
(b)	any <b>one</b> from:		1
	<ul style="list-style-type: none"> <li>four reactant molecules but only two product molecules (owtte)</li> <li>increase in pressure favours the reaction which produces the least number of molecules</li> </ul>	reverse reaction goes from 2 molecules / moles / volumes to 4 molecules / moles / volumes	
	at low temperatures the reaction is too slow	decrease in pressure favours the back reaction because it produces the most molecules	
	high pressures could be dangerous / expensive		
		accept compromise between yield and rate	1
		450 °C gives a reasonable yield at a reasonable rate	
		catalyst does not work at low temperatures	
		accept 200 atmospheres gives a reasonable yield at reasonable cost / safely	1
		for 1 mark 450 °C and 200 atmospheres are compromise conditions	

continued...

**Question 4 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(c)(i)	heat is recycled / heat from the reactor is used to heat gases going into the reactor		1
	unreacted nitrogen and hydrogen are recycled		1
(ii)	sensible comment related to conservation of energy	eg cost of energy pollution aspects of burning fuels to provide energy etc.	1
	sensible comment related to conservation of materials	eg cost of materials cost of converting raw materials into nitrogen and hydrogen natural gas is non-renewable source	1
<b>Total</b>			<b>10</b>

### Question 5

	answers	extra information	mark
(a)	$M_r(\text{SiO}_2) = 60$ $60 \text{ g SiO}_2 \rightarrow 28 \text{ g Si}$ $2.14 \text{ g SiO}_2 \rightarrow 1 \text{ g Si}$  $M_r(\text{SiO}_2) = 60$ moles of silicon needed = $\frac{1}{28} = 0.0357$ mass of $\text{SiO}_2$ needed = $0.0357 \times 60$ = 2.14g  $M_r(\text{SiO}_2) = 60$ mass $\text{SiO}_2 = 1 \times \left(\frac{60}{28}\right)$ = 2.14g	correct answer gains <b>3</b> marks  if $M_r$ incorrect ecf max <b>2</b>  allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2  a unit is not required but an incorrect unit loses the third mark  <b>1</b> mark  <b>1</b> mark  allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2  <b>1</b> mark  <b>1</b> mark  allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2	3

continued...

Question 5 continued

	answers	extra information	mark
(b)(i)	$\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$	penalise incorrect symbols  correctly balanced equation gains <b>1</b> mark  state symbols gains <b>1</b> mark  allow correct multiples / fractions	2
(ii)	$\begin{array}{c} \text{H} \\ \times \\ \bullet \\ \text{H} \times \text{Si} \times \text{H} \\ \times \\ \bullet \\ \text{H} \end{array}$ <p>or</p>	ignore inner shell electrons of silicon  allow correct drawings without symbols  must clearly indicate four shared pairs of electrons with one electron from each atom	1
(c)(i)	95 (%)		1
(ii)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• sensible ideas such as:</li> <li>• sand contains impurities / it is not pure</li> <li>• silicon dioxide</li> <li>• silicon hydrides also produced</li> <li>• loss of product during filtering etc</li> </ul>		1
<b>Total</b>			<b>8</b>

### Question 6

	answers	extra information	mark
(a)(i)	layers / lattice / giant structure / regular pattern of atoms (diagram)	allow layers / lattice / giant structure / regular pattern of ions  do <b>not</b> accept particles	1
	outer (shell) electrons	accept valence electrons	1
	(free to) move (through whole structure)	accept delocalised / mobile / free	1
(ii)	the free electrons (allow the metal to conduct electricity)	accept electrons move / mobile / delocalised	1
(iii)	atoms / ions / layers can slide / slip / move over each other		1
(b)(i)	copper oxide formed or Cu reacts with oxygen or Cu is oxidised		1
	this is a poor conductor <b>or</b> gets in the way of free moving electrons <b>or</b> fewer mobile electrons	do <b>not</b> accept electricity	1
	<b>or</b> oxygen atoms / oxygen molecules / oxide ions in metal	do <b>not</b> accept oxygen pockets / bubbles  do <b>not</b> accept macro explanations	
	prevents / disrupts flow of electrons / current or fewer mobile electrons	do <b>not</b> accept electricity	
(ii)	any <b>one</b> from:  <ul style="list-style-type: none"> <li>• hydrogen reacts with oxygen</li> <li>• water is formed</li> <li>• hydrogen reduces copper oxide etc</li> </ul>		1
<b>Total</b>			<b>8</b>
		<b>Overall marks</b>	<b>45</b>



Surname					Other Names				
Centre Number					Candidate Number				
Candidate signature									

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General Certificate of Secondary Education  
Specimen Paper

**CHEMISTRY**  
**Unit Chemistry 3**

**Foundation Tier**

Date and Time

**F**



<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a ruler</li> <li>• the data sheet (enclosed)</li> </ul> <p>You may use a calculator.</p>
---

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4		8	
Total (Column 1) →			
Total (Column 2) →			
<b>TOTAL</b>			
Examiner's Initials			

Time allowed: 45 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

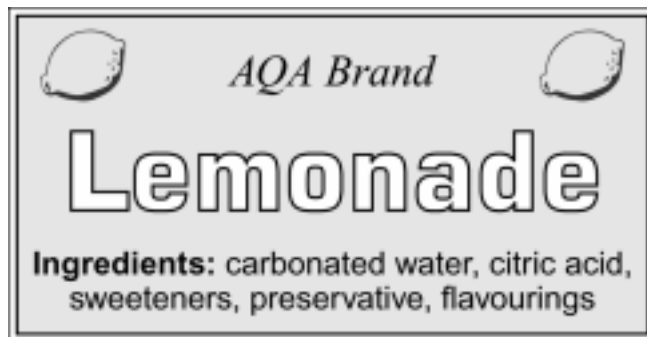
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

**Advice**

- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

- 1 This label was on a bottle of lemonade.



- (a) Carbonated water is made by dissolving a gas in water.

Draw a ring around the name of this gas.

**carbon monoxide      carbon dioxide      hydrogen      oxygen**

(1 mark)

- (b) Complete the sentence by crossing out the **two** words that are wrong.

To make as much of this gas as possible dissolve in water, the temperature

should be

high  
low

and the pressure should be

high  
low

(1 mark)

- (c) Choose **one** substance from the other ingredients on the label that produces hydrogen ions ( $\text{H}^+(\text{aq})$ ) when dissolved in water.

.....  
(1 mark)

- 2 Choose from the list in the box the part of the periodic table to which each element belongs. The periodic table on the Data Sheet may help you to answer this question.

Group 1	Group 2	Transition elements	Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
------------	------------	------------------------	------------	------------	------------	------------	------------	------------

- (a) A green/yellow gas which is a non-metal. It forms ions with a  $1^-$  charge.

It is in .....  
(1 mark)

- (b) The atoms of this element have 12 protons in the nucleus.

It is in .....  
(1 mark)

- (c) A soft metal which is shiny when cut. It forms ions with a  $1^+$  charge.

It is in .....  
(1 mark)

- (d) A shiny metal with a high melting point. It forms coloured compounds and is often used as a catalyst.

It is in .....  
(1 mark)

**Turn over for the next question**

- 3 Cod can be cooked by steaming or by deep frying in fat.



The table shows the energy available from a 200 g portion of steamed cod and a 200 g portion of deep fried cod.

	Mass of cod in grams	Energy available in calories	Energy available in joules
Steamed cod	200 g	160	672
Deep fried cod	200 g	410	?

- (a) The energy available in calories can be converted to joules using the equation shown below.

$$\text{Energy in joules} = \text{Energy in calories} \times 4.2$$

Use this equation to help you to calculate the energy available in joules from 200 g of deep fried cod.

.....

Energy available from 200 g of deep fried cod = .....J  
(1 mark)

- (b) Explain why deep fried cod has a lot more available energy than the steamed cod.

.....  
.....  
.....  
.....

(2 marks)

(c) Suggest why eating too much deep fat fried food could be bad for your health.

.....  
.....

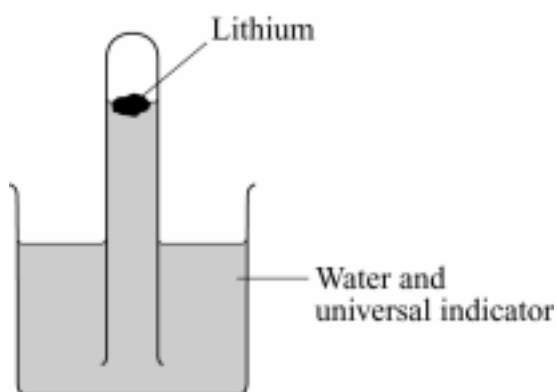
*(1 mark)*

4
---

**Turn over for the next question**

**There are no questions printed on this page**

- 4 The diagram shows an experiment to study the reaction of lithium with water.



- (a) Describe, as fully as you can, what you would see as the lithium reacts with the water in this experiment.

.....

.....

.....

.....

.....

.....

(3 marks)

- (b) The reaction has two products. Complete the word equation for this reaction by choosing the correct substances from the box.

hydrogen	lithium hydride	oxygen
lithium	lithium hydroxide	

Lithium + water → ..... + .....  
(2 marks)

- (c) Caesium is lower down in Group 1 of the Periodic Table than lithium.  
Complete this sentence by crossing out the words in the box that are wrong.

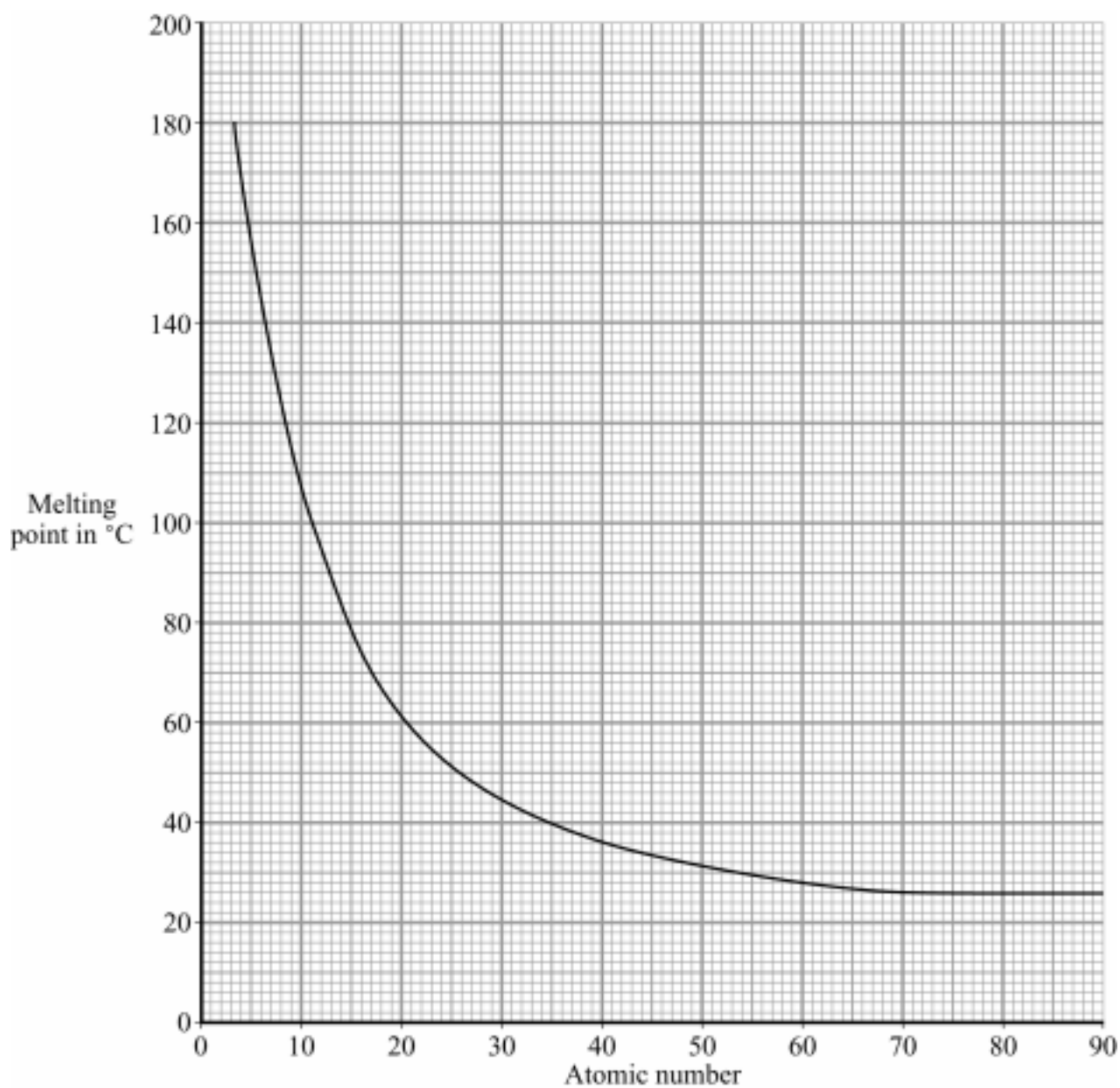
Caesium

is less reactive than  
is more reactive than  
has the same reactivity as

lithium.

(1 mark)

- (d) The graph shows the melting points of the Group 1 metals plotted against the atomic numbers.





- (i) Describe fully how the melting points change as the atomic number increases.

.....  
.....  
.....

(2 marks)

- (ii) Francium has an atomic number of 87.

Use the graph to estimate the melting point of francium.

Estimate of melting point ..... °C  
(1 mark)

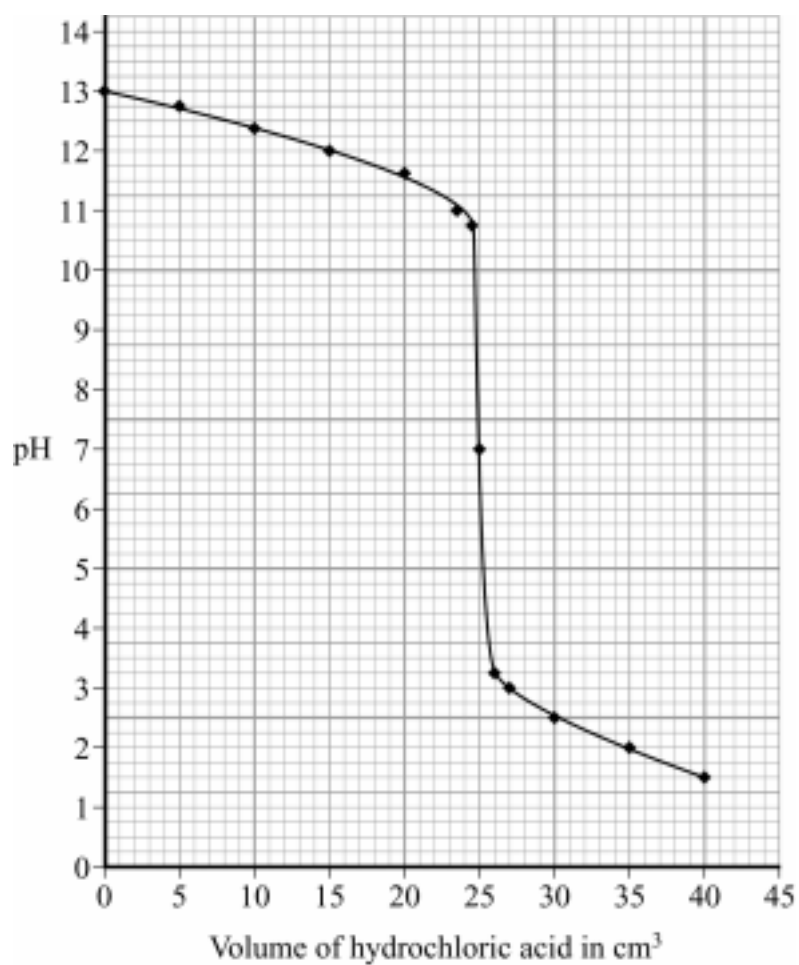
9
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**Turn over for the next question**

- 5 A chemist used a titration to investigate a solution used to unblock drains.



25cm<sup>3</sup> of a diluted solution of Drain Opener was put into a beaker. The graph shows how the pH of this solution changed as hydrochloric acid was slowly added.



- (a) What volume of hydrochloric acid was needed to neutralise the Drain Opener solution?

Volume = ..... cm<sup>3</sup>  
(1 mark)

- (b) Which of the following best describes Drain Opener solution?

Draw a ring around your answer.

**neutral            strong acid            strong alkali            weak acid            weak alkali**

(1 mark)

- (c) Which of the following would be best for accurately measuring the volume of hydrochloric acid added?

Draw a ring around your answer,

**beaker            burette            measuring cylinder            pipette**

Give a reason for your choice.

.....  
.....  
.....  
.....

(2 marks)

4
---

**Turn over for the next question**

6 Chemical tests can be used to identify compounds.

- (a) **List A** gives the names of four compounds in solution. **List B** gives tests and the result of the tests.

Draw a straight line from each compound in **List A** to its test and result of the test in **List B**. The first one has been done for you.

List A Name of compound in solution	List B Test and result of the test
Calcium chloride	Add barium chloride solution and dilute hydrochloric acid. A white precipitate is formed.
Lithium sulfate	Do the flame test. Yellow flame produced.
Potassium carbonate	Add silver nitrate solution and dilute nitric acid. A white precipitate is formed.
Sodium nitrate	Add hydrochloric acid. Carbon dioxide gas given off.

(2 marks)

- (b) State what you would see when sodium hydroxide solution reacts with copper sulfate solution.

.....  
 .....

(2 marks)

- (c) (i) Name **one** instrumental method which can be used to help in the identification of substances.

.....  
 .....

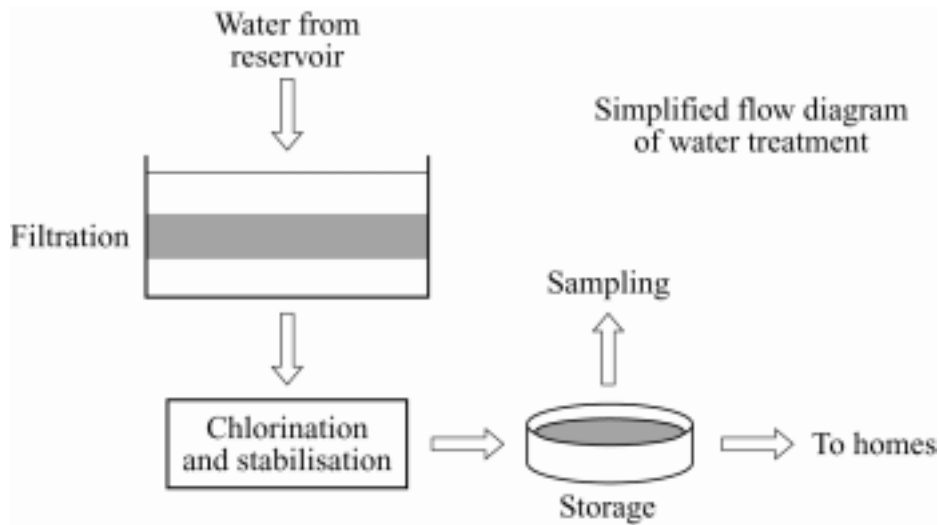
(1 mark)

- (ii) Suggest **one** advantage of the instrumental method you have named.

.....

(1 mark)

7 The diagram shows a simplified flow diagram of a water treatment works which supplies drinking water.



(a) Explain the purpose of:

(i) filtration

.....  
.....

(ii) chlorination.

.....  
.....

(2 marks)

(b) Samples of the treated water must be tested at regular intervals.

(i) Suggest why.

.....  
.....  
.....  
.....

(2 marks)

Question 7 continues on the next page

- (ii) Suggest how the use of ICT and/or data logging equipment could help with this testing.

.....  
.....  
.....  
.....

*(2 marks)*

- (c) Drinking water can also be produced using distillation.

Explain why this process is expensive.

.....  
.....

*(1 mark)*

- (d) In some parts of the country the water supplied to homes is hard water.

- (i) Name **one** ion that can make water hard.

.....

*(1 mark)*

- (ii) Explain how hard water can affect central heating systems.

.....  
.....  
.....  
.....

*(2 marks)*

- (iii) State **one** advantage of hard water.

.....

*(1 mark)*

- 8 The table shown below was devised by John Newlands in 1864. He arranged the elements in order of their relative atomic masses. He found a repeating pattern, with elements having similar properties in the vertical columns (Groups). He called this pattern the ‘Law of Octaves’, because elements with similar properties seemed to be repeated every eighth element.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co/Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce/La	Zr	Di/Mo	Ro/Ru
Pd	Ag	Cd	U	Sn	Sb	Te
I	Cs	Ba/V	Ta	W	Nb	Au
Pt/Ir	Tl	Pb	Th	Hg	Bi	Os

- (a) Many scientists were critical of Newlands’ Law of Octaves.

Suggest why other scientists in 1864 were critical of the Law of Octaves.

You should give examples from the table and use your knowledge of the chemistry of the elements.

.....

.....

.....

.....

.....

.....

(3 marks)

**Question 8 continues on the next page**

- (b) The diagram below shows a version of Mendeleev's Periodic Table of 1871. Mendeleev placed most of the elements in order of relative atomic mass.

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

This table became accepted by other scientists.

Give **one** way in which Mendeleev's table improved on Newlands' table.

.....

.....

(1 mark)

4
---

**END OF QUESTIONS**



## Chemistry 3F Mark Scheme

### Question 1

	answers	extra information	mark
(a)	carbon dioxide		1
(b)	low <b>and</b> high	<b>both</b> required for mark	1
(c)	citric acid		1
<b>Total</b>			<b>3</b>

### Question 2

	answers	extra information	mark
(a)	group 7		1
(b)	group 2		1
(c)	group 1		1
(d)	transition metals		1
<b>Total</b>			<b>4</b>

### Question 3

	answers	extra information	mark
(a)	1722 (J)	accept 1.722 kJ (unit must be given)	1
(b)	cooked in fat		1
	fat very high in energy		1
(c)	obesity etc		1
<b>Total</b>			<b>4</b>

#### Question 4

	answers	extra information	mark
(a)	any <b>three</b> from: <ul style="list-style-type: none"><li>• floats</li><li>• fizzes / bubbles or produces a gas</li><li>• indicator goes blue / purple / violet (alkaline colour)</li><li>• water level in test tube goes down <b>or</b> gas fills the test tube</li><li>• lithium dissolves (owtte)</li><li>• moves around (on surface of water)</li><li>• steam</li></ul>		3
(b)	lithium hydroxide		1
	hydrogen		1
(c)	is more reactive than		1
(d)(i)	decreases		1
	and then slows or levels off		1
(ii)	26 (°C)		1
<b>Total</b>			<b>9</b>

### Question 5

	answers	extra information	mark
(a)	25 (cm <sup>3</sup> )		1
(b)	strong alkali		1
(c)	burette plus any sensible reason: eg <ul style="list-style-type: none"><li>• more accurate</li><li>• smaller divisions</li><li>• tap allows better control</li></ul> etc		1 1
<b>Total</b>			<b>4</b>

### Question 6

	answers	extra information	mark
(a)		all correct = <b>2</b> marks one or two correct = <b>1</b> mark	2
(b)	blue		1
	precipitate	accept solid formed	1
(c)(i)	any <b>one</b> sensible method: eg • infra red spectroscopy • nmr / mass spectroscopy etc		1
(ii)	any <b>one</b> from: • detect very small amounts / sensitive • fast • accurate etc		1
<b>Total</b>			<b>6</b>

### Question 7

	answers	extra information	mark
(a)(i)	to remove solids		1
(ii)	to kill germs / bacteria / microbes etc		1
(b)(i)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• check for dissolved minerals</li> <li>• check for microbes</li> <li>• which could be harmful to health</li> </ul>		2
(ii)	any <b>two</b> sensible answers such as: <ul style="list-style-type: none"> <li>• monitor continuously</li> <li>• record results</li> <li>• immediate graphical display</li> <li>• take samples automatically</li> </ul> etc		2
(c)	cost of fuel / heat etc		1
(d)(i)	calcium / magnesium	accept symbols	1
(ii)	produces scale (owtte)		1
	reduces efficiency / blocks pipes etc		1
(iii)	any sensible reason  eg  good for health		1
<b>Total</b>			<b>11</b>

### Question 8

	answers	extra information	mark
(a)	<p>comment + relevant example gains <b>1 + 1</b> marks</p> <p>third marking point can be either a comment or an example unrelated to first comment ie 3 comments would be max <b>2</b> marks</p> <p>(could be many answers)</p> <p>eg many elements in the groups have very dissimilar properties eg Cu + K gains <b>2</b> marks</p> <p>two elements in one place on the table eg Ce or La gains <b>2</b> marks</p> <p>no clear division between metals and nonmetals <b>or</b> metals and non-metals jumbled / mixed up (could give example from table)</p> <p>Newlands didn't allow spaces for new elements</p>	ignore references to music	3

continued...

**Question 8 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(b)	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• elements with dissimilar properties are separated or grouped elements with similar properties</li> <li>• gaps left for elements to be added when discovered</li> <li>• relative atomic mass order not followed in all cases (so that elements go in groups with other similar elements)</li> <li>• Mendeleev in proton number order groups related to electronic structure or group number equals number of outer electrons</li> <li>• new groups created or iron, cobalt and nickel in a group or eight groups instead of seven</li> <li>• correct elements in periods two and three reactivity trends in groups or reactivity trends across periods separates metals and non-metals</li> </ul>		1
<b>Total</b>			<b>4</b>
		<b>Overall marks</b>	<b>45</b>

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		Other Names		
Centre Number			Candidate Number	
Candidate signature				

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General Certificate of Secondary Education  
Specimen Paper

**CHEMISTRY**  
**Unit Chemistry 3**

**Higher Tier**

Date and Time



**H**

<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a ruler</li> <li>• the data sheet (enclosed)</li> </ul> <p>You may use a calculator.</p>
---

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4			
Total (Column 1)		→	
Total (Column 2)		→	
<b>TOTAL</b>			
Examiner's Initials			

Time allowed: 45 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

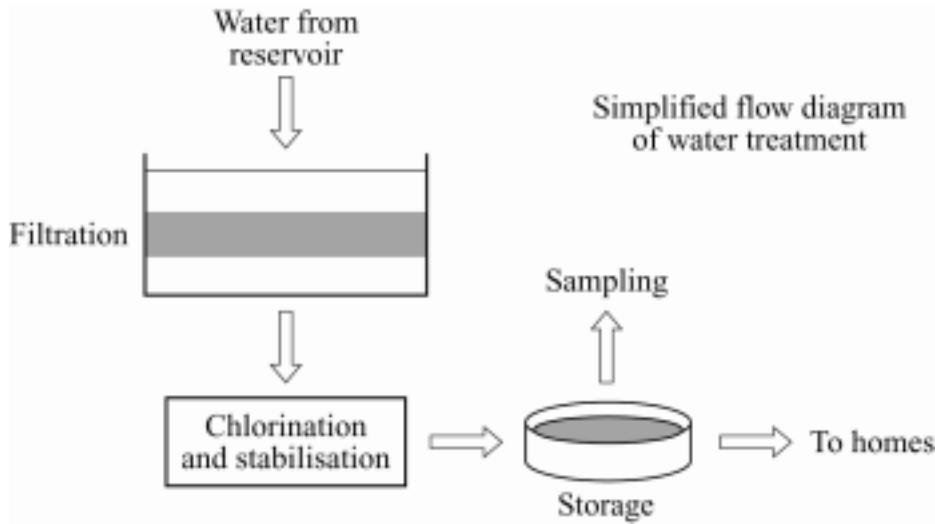
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

**Advice**

In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

- 1 The diagram shows a simplified flow diagram of a water treatment works which supplies drinking water.



- (a) Explain the purpose of:

- (i) filtration

.....  
.....

- (ii) chlorination.

.....  
.....

(2 marks)

- (b) Samples of the treated drinking water must be tested at regular intervals.

- (i) Suggest why.

.....  
.....  
.....  
.....

(2 marks)

(ii) Suggest how the use of ICT and/or data logging equipment could help with this testing.

.....  
.....  
.....  
.....

(2 marks)

(c) Drinking water can also be produced using distillation.

Explain why this process is expensive.

.....  
.....

(1 mark)

(d) In some parts of the country the water supplied to homes is hard water.

(i) Name **one** ion that can make water hard.

.....

(1 mark)

(ii) Explain how hard water can affect central heating boilers.

.....  
.....  
.....  
.....

(2 marks)

(iii) State **one** advantage of hard water.

.....

(1 mark)

**Turn over for the next question**

- 2 The table below was devised by John Newlands in 1864. He arranged the elements in order of their relative atomic masses. He found a repeating pattern, with elements having similar properties in the vertical columns (Groups). He called this pattern the ‘Law of Octaves’, because elements with similar properties seemed to be repeated every eighth element.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co/Ni	Cu	Zn	Y	In	As	S
Br	Rb	Sr	Ce/La	Zr	Di/Mo	Ro/Ru
Pd	Ag	Cd	U	Sn	Sb	Te
I	Cs	Ba/V	Ta	W	Nb	Au
Pt/Ir	Tl	Pb	Th	Hg	Bi	Os

- (a) Many scientists were critical of Newlands’ Law of Octaves.

Suggest why other scientists were critical of the Law of Octaves.

You should give examples from the table and use your knowledge of the chemistry of the elements.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

- (b) The diagram below shows a version of Mendeleev's Periodic Table of 1871. Mendeleev placed most of the elements in order of relative atomic mass.

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

This table became accepted by other scientists.

Give **one** way in which Mendeleev's table improved on Newlands' table.

.....

.....

(1 mark)

4
---

**Turn over for the next question**

3 Caesium is an element in Group 1 of the periodic table.

(a) Which of the electronic structures represented by **A** to **D** is correct for a caesium atom?

The periodic table on the Data Sheet may help you to answer this question.

	Electronic structure
<b>A</b>	2, 8, 18, 8, 1
<b>B</b>	2, 8, 18, 18, 9
<b>C</b>	2, 8, 18, 27
<b>D</b>	2, 8, 18, 18, 6, 3

The electronic structure for a caesium atom is represented by letter .....  
(1 mark)

(b) When a small piece of lithium is added to cold water, it fizzes around on the surface of the water. A small piece of caesium explodes when added to water.

Explain in terms of electronic structure why a caesium atom is more reactive than a lithium atom.

.....

.....

.....

.....

(2 marks)

- 4 Many soft drinks contain citric acid.



- (a) In 1883, a young chemist called Svante Arrhenius suggested that a molecule can break into ions when dissolved in a solvent. He later developed this theory to explain what happens when an acid dissolves in water.

Older scientists believed that molecules could not break up and could not carry an electrical charge.

- (i) Use the ideas of Arrhenius to explain why the Lemon 'n Lime drink is acidic.

.....

.....

.....

.....

(2 marks)

- (ii) Suggest why older chemists would not accept Arrhenius' ideas.

.....

.....

.....

(1 mark)

- (b) Citric acid is a weak acid.

Explain, in terms of ions, why Lemon 'n Lime is safe to drink, whereas a solution containing a strong acid may be corrosive.

.....

.....

.....

(2 marks)

5
---

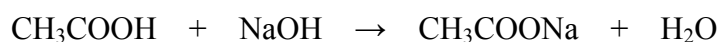
- 5 (a) This label has been taken from a bottle of vinegar.



Vinegar is used for seasoning foods. It is a solution of ethanoic acid in water.

In an experiment, it was found that the ethanoic acid present in a  $15.00 \text{ cm}^3$  sample of vinegar was neutralised by  $45.00 \text{ cm}^3$  of sodium hydroxide solution, of concentration  $0.20$  moles per cubic decimetre (moles per litre).

The equation which represents this reaction is



Calculate the concentration of the ethanoic acid in this vinegar:

- (i) in moles per cubic decimetre (moles per litre)

.....

.....

.....

.....

Concentration = ..... moles per cubic decimetre  
(2 marks)

- (ii) in grams per cubic decimetre (grams per litre).

Relative atomic masses: H = 1; C = 12; O = 16.

.....

.....

.....

Concentration = ..... grams per cubic decimetre  
(2 marks)



- (b) Further titrations were carried out to investigate other brands of vinegar. The same method was used as in part 5(a).

The titration was performed three times for each brand of vinegar.

	Volume of 0.20 mol dm <sup>-3</sup> sodium hydroxide solution needed to neutralise 15 cm <sup>3</sup> of the vinegar in cm <sup>3</sup>			
	Brand 1	Brand 2	Brand 3	Brand 4
Titration 1	45.4	46.3	45.8	46.1
Titration 2	44.7	44.5	45.4	45.0
Titration 3	45.1	45.1	45.6	45.1

- (i) Which brand of vinegar appears to contain the highest concentration of ethanoic acid?

Brand .....

Explain how you decided.

.....

.....

.....

.....

(2 marks)

- (ii) Are the results of these titrations good enough to be certain which brand contains the most ethanoic acid?

Explain your answer.

.....

.....

.....

.....

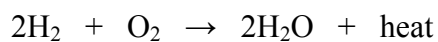
(2 marks)



**Turn over for the next question**

7 “HYDRODGEN - *FUEL OF THE FUTURE*”.

It has been suggested that hydrogen could be used as a fuel instead of the fossil fuels that are used at present. The equation below shows how hydrogen burns in air.



- (a) Hydrogen was successfully used as a fuel for a Soviet airliner in 1988.

Suggest why burning hydrogen might cause less pollution problems than burning fossil fuels.

.....

.....

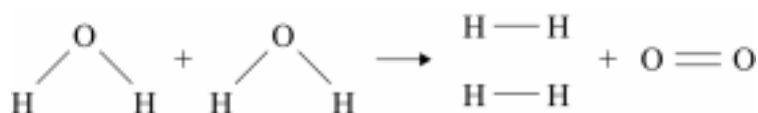
.....

.....

(2 marks)

- (b) Hydrogen can be made by splitting up water molecules.

The water splitting reaction can be represented by the equations below.



The table gives some bond energies.

Bond	Bond energy in kJ per mole
O—H	464
H—H	436
O=O	498

- (i) Calculate the energy transferred in this reaction.

.....

.....

.....

.....

.....

.....

Energy transferred ..... kJ / mol  
(3 marks)

- (ii) Explain, in terms of bond energies, why this reaction is endothermic.

.....

.....

.....

.....

(2 marks)

- (c) The energy needed for the water splitting reaction can be obtained from renewable sources of energy such as wind or solar power.

The hydrogen produced by this reaction can be stored in large tanks ready for use.

Suggest why the stored hydrogen could be more useful as a fuel than using wind or solar power directly.

.....

.....

(1 mark)

8
---

**END OF QUESTIONS**

## Chemistry 3H Mark Scheme

### Question 1

	answers	extra information	mark
(a)(i)	to remove solids		1
(ii)	to kill germs / bacteria / microbes etc		1
(b)(i)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• check for dissolved minerals</li> <li>• check for microbes</li> <li>• which could be harmful to health</li> </ul>		2
(ii)	any <b>two</b> sensible answers such as: <ul style="list-style-type: none"> <li>• monitor continuously</li> <li>• record results</li> <li>• immediate graphical display</li> <li>• take samples automatically</li> </ul> etc		2
(c)	cost of fuel / heat etc		1
(d)(i)	calcium / magnesium	accept symbols	1
(ii)	produces scale (owtte)		1
	reduces efficiency / blocks pipes etc		1
(iii)	any sensible reason eg good for health		1
<b>Total</b>			<b>11</b>

## Question 2

	answers	extra information	mark
(a)	<p>comment + relevant example gains <b>1 + 1</b> marks</p> <p>third marking point can be either a comment or an example unrelated to first comment ie 3 comments would be max <b>2</b> marks</p> <p>(could be many answers)</p> <p>eg many elements in the groups have very dissimilar properties eg Cu + K gains <b>2</b> marks</p> <p>two elements in one place on the table eg Ce or La gains <b>2</b> marks</p> <p>no clear division between metals and nonmetals <b>or</b> metals and non-metals jumbled / mixed up (could give example from table)</p> <p>Newlands didn't allow spaces for new elements</p>	ignore references to music	3

continued...

**Question 2 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(b)	any <b>one</b> from: <ul style="list-style-type: none"><li>• elements with dissimilar properties are separated or grouped elements with similar properties</li><li>• gaps left for elements to be added when discovered</li><li>• relative atomic mass order not followed in all cases (so that elements go in groups with other similar elements)</li><li>• Mendeleev in proton number order groups related to electronic structure or group number equals number of outer electrons</li><li>• new groups created or iron, cobalt and nickel in a group or eight groups instead of seven</li><li>• correct elements in periods two and three reactivity trends in groups or reactivity trends across periods separates metals and non-metals</li></ul>		1
<b>Total</b>			<b>4</b>



### Question 3

	answers	extra information	mark
(a)	A	accept a or 2, 8, 18, 18, 8, 1	1
(b)	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>outer shell further from nucleus</li> <li>outer shell electron less strongly attracted to nucleus</li> <li>outer shell more shielded</li> </ul> <p>so outer shell electron lost more easily (owtte)</p>	<p>do <b>not</b> accept more shells or bigger / larger atoms alone</p> <p>accept correct converse linked to lithium            'it' must be linked to caesium            'outer' must be used once at least for both marks</p>	<p>1</p> <p>1</p>
<b>Total</b>			<b>3</b>

#### Question 4

	answers	extra information	mark
(a)(i)	(some) citric acid molecules split (into ions) / dissociate		1
	to form hydrogen ions / $H^+$ / protons / hydrated protons		1
(ii)	any <b>one</b> from sensible ideas such as: <ul style="list-style-type: none"><li>• reluctant to change existing ideas</li><li>• questioned status of Arrhenius</li><li>• questioned validity / credibility of evidence</li></ul> etc		1
(b)	citric acid only partly dissociates <b>or</b> produces only a low concentration of / a few aqueous hydrogen ions		1
	hydrochloric acid completely dissociates <b>or</b> produces a high concentration / lot of aqueous hydrogen ions.		1
<b>Total</b>			<b>5</b>

### Question 5

	answers	extra information	mark
(a)(i)	eg moles NaOH = moles of acid $= 0.2 \times \frac{45}{1000} = 0.009$ rounding to 0.01 loses <b>1</b> mark $= 0.009 \times \frac{1000}{15} = 0.6 \text{ (M)}$ ecf for arithmetical error	or formula: $15M_1 = 0.2 \times 45$  $M_1 = 0.6 \text{ (M)}$  <b>1</b> mark for working correct answer gains <b>2</b> marks	2
(ii)	36	correct answer gains <b>2</b> marks  ecf – (a)(i) $\times$ 60 gains <b>2</b> marks if correctly calculated  $0.6 \times 60$ gains <b>1</b> mark  relative formula mass of ethanoic acid = 60 gains <b>1</b> mark  $0.6 \times$ incorrect molar mass gains <b>1</b> mark only	2
(b)(i)	brand 3		1
	highest average		1
(ii)	no	scores no mark (yes gains max <b>1</b> )	
	errors for individual results (owtte)	idea of errors / large errors	1
	bigger than difference between values (owtte)	errors greater than differences between averages (owtte)	1
<b>Total</b>			<b>8</b>

### Question 6

	answers	extra information	mark
	any series of chemical tests that work should be given credit identifying all four substances unambiguously with no errors gains <b>6 marks</b>  eg		
	flame test: yellow / orange means sodium ions so sodium sulfate	ignore incorrect flame test colours for other compounds	1
	add NaOH to remaining three samples		1
	no (white) ppt / ammonia means ammonium ion so ammonium sulfate	(damp red) litmus* goes blue means ammonium sulfate  *or UI / pH indicator goes blue / purple	1
	(white) ppt means magnesium ions / magnesium ions		1
	add excess NaOH to the two samples which gave a (white) ppt:		1
	ppt dissolves then aluminium sulfate ppt insoluble means magnesium sulfate		

continued...

**Question 6 continued**

	<b>answers</b>	<b>extra information</b>	<b>mark</b>
	<p><b>or</b></p> <p>add NaOH:</p> <p>no ppt: ammonia produced means ammonium sulfate</p> <p>the other one with no ppt is sodium sulfate</p> <p>add excess NaOH to the two samples which gave the white ppt</p> <p>ppt dissolves then aluminium sulfate</p> <p>ppt insoluble then magnesium sulfate</p>		
<b>Total</b>			<b>6</b>

### Question 7

	answers	extra information	mark
(a)	water is the only product when hydrogen is burned		1
	water does not cause pollution		1
	<b>or</b> fossil fuels produce polluting gases / named polluting gases		
(b)(i)	bonds broken 1856 kJ	<b>3 marks for correct answer</b>	1
	bonds formed 1370 kJ		1
	energy transferred = $1856 - 1370 = 480$ (kJ)	ecf allowed ignore signs	1
(ii)	more energy is needed to break bonds than is given out when bonds are formed	idea of bond breaking needing energy and bond forming releasing energy	2
(c)	wind / solar is variable / not reliable / stops and starts etc		1
	<b>or</b> store of hydrogen gives a constant supply (owtte)		
<b>Total</b>			<b>8</b>
		<b>Overall marks</b>	<b>45</b>

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**Teachers' Notes**  
**ISA – Chemistry 1 – Testing Concrete**  
**Specimen Material**

This ISA relates to: Chemistry 1, Section 12.1

Preparation sheet for an investigation into the making and testing of concrete. This work should be carried out during the teaching of the Section 'How do rocks provide building materials?' (ref: 12.1).

**How do rocks provide building materials?**

The investigation should include changing the method of preparation of concrete from cement, sand, water and crushed rock or pebbles and relating this to the strength of the concrete made.

Suggested outline approach:

Candidates should consider how they might vary the proportions of the ingredients for making concrete. They should tackle this in a very precise manner, with just one independent variable. They should suggest or be given a prediction which relates the method of production to the strength of the concrete. They would be expected to decide upon ranges for the independent variable when given information about the different mixes used in the building trade.

Candidates could then make small bar shaped blocks of concrete, preferably quite narrow and long, to allow for easier testing. The dependent variable will assess the strength of the concrete. This again could be given to the candidates as an outline method. The simplest way would be to span the block across a pair of stools to make a bridge. Masses could then be suspended from the middle of the block. With limited facilities, it might be easier to make cement blocks without the crushed rock or pebbles.

Candidates should be given advice that their methods might not yield the clear results that other science investigations often do. This would be due to the many control variables required in the making of the concrete.

Centres are reminded that there are **Health and Safety** issues involved in the use of cement powder, and in the testing of the concrete blocks. As always, risk assessments must be made prior to the candidates working.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.



**GCSE Science – Investigative Skills Assignment  
Chemistry 1 – Testing Concrete  
Specimen Material**

Centre number						Candidate number					Today's date	.../.../...
Candidate name (please print)											Are your own results submitted with this ISA?	YES/NO (delete one)

**Instructions**

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		Section 2	
		Total (max 34)	

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

### Section 1

These questions refer to **your own investigation** that you carried out with concrete. You should use your own results, your graph/s and what you remember about doing your investigation to answer these questions. All answers should be in the spaces provided.

- 1 Describe clearly what you were trying to find out in your investigation. Identify your dependent and independent variables.

*Quality of written communication is important in this answer.*

.....

.....

.....

.....

.....

.....

.....

.....

*(4 marks)*

- 2 Describe briefly how you measured your dependent variable.

.....

.....

*(1 mark)*

- 3 Describe one variable that you controlled *while you were making* your concrete blocks.

.....

.....

*(1 mark)*

- 4 Describe anything you noticed about how your concrete blocks broke when they were tested.

.....

.....

*(1 mark)*



5 If you were able to compare your results with others in your class and all of the results were about the same, this would make your results:  
Tick the box beside the correct answer.

- more accurate
- more precise
- more reliable
- more valid

(1 mark)

6 Suggest a change in your method that could improve the validity of your results.

.....  
.....

(1 mark)

7 Explain how human error might have affected your results.

.....  
.....

(1 mark)

8 Which, if any, of your results do you need to repeat?

.....

(1 mark)

9 Explain your answer to Question 8.  
(Why did you choose to repeat those particular results or why there were no results you wish to repeat?)

.....  
.....

(1 mark)

10 What was the relationship between your independent and your dependent variable?

.....  
.....

(1 mark)

- 11** Look back to Question 1, where you wrote down what you were trying to find out. Now write down what you **did** find out from this investigation.

.....  
.....

*(1 mark)*

- 12** Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

*(6 marks)*

<hr/> <b>20</b>
-----------------

## Section 2

These questions relate to an investigation that is similar to the one that you carried out. You should use the results below, as well as your own understanding of how these investigations are carried out, to answer the questions.

Harry needed a concrete drive up to his garage. It worked well for several weeks and then started to crumble. He complained to the company that had supplied the concrete. They sent a technician to take samples to test. They took 10 core samples 100 mm in diameter and 100 mm long. These were put into a press and a force applied. The results are in Table 1 below.

There is some suspicion that the concrete used might have been made with different amounts of water.

Tests were carried out to see the effect of using different amounts of water on the strength of new concrete. (Table 2)

**Table 1**

Sample number (metres from the roadside)	Force applied to crush the concrete (N/mm <sup>2</sup> )
1	50
2	51
3	38
4	36
5	38
6	37
7	25
8	26
9	23
10	25
<b>Average</b>	

**Table 2**

Extra water added to concrete (Litres/m <sup>3</sup> )	Force applied to crush the concrete (N/mm <sup>2</sup> )		
None	36.1	34.9	35.2
10	32.2	31.8	33.0
20	29.8	32.7	29.4
30	26.3	25.7	26.5

- 13 Complete Table 1 by filling in the average.

*(1 mark)*

**Turn over for the next question**

**14** How could you best describe the type of measurements in Table 1?  
Tick the box beside the correct answer.

- Categoric measurements
- Ordered measurements
- Discreet measurements
- Continuous measurements

(1 mark)

**15** The industry recommended minimum strength for concrete on drives is 35.0N/mm<sup>2</sup>.  
The concrete company claimed that the concrete mix was therefore satisfactory and indeed ‘many of the readings exceeded the industry minimum requirements’.

(a) Do you agree with the concrete company?  
Explain your answer.

.....

.....

.....

(1 mark)

(b) Suggest why the concrete company were keen to reassure Harry that the concrete mix *was* satisfactory.

.....

.....

(1 mark)

(c) The concrete company said that the results which were less than the recommended 35.0N/mm<sup>2</sup> were due to natural variation. Harry decided to ask another firm to repeat the tests. Explain why this was a good idea.

.....

.....

(1 mark)

**16** Describe *fully* the relationship between the distance from the roadside and the strength of the concrete.

.....

.....

(1 mark)

17 Study Table 2.  
Which would be the best way of presenting these results?  
Tick the box beside the correct answer.

- Bar chart
- Line graph
- Pie chart
- Histogram

(1 mark)

18 There is one anomalous result shown in Table 2.  
Draw a ring around this result.

(1 mark)

19 From Table 2 which results show the greatest precision?  
Tick the box beside the correct answer.

- No added water
- 10 litres/m<sup>3</sup>
- 20 litres/m<sup>3</sup>
- 30 litres/m<sup>3</sup>

(1 mark)

20 What was the dependent variable for the second investigation?

.....  
(1 mark)

21 Use knowledge from your own investigation to suggest **one** reason why the results for each amount of water in Table 2 vary.

.....  
.....  
(1 mark)

22 The technician had another force meter with a wider range that measured to 1 N/mm<sup>2</sup>.  
Was this a suitable instrument to use?  
Explain your answer.

.....  
.....  
(1 mark)

23 What does Table 2 suggest about the problem that Harry had with his concrete drive?

.....  
.....

(1 mark)

24 How should the results for Table 2 be treated?  
Tick the box beside the correct answer.

The best set of results should be kept, and the anomaly discarded

The results of all the tests should be averaged to find the mean

The results for each extra test that used water should include any anomalous result in finding the mean.

The results for each extra test that used water should exclude any anomalous results in finding the mean

(1 mark)

14
----

**END OF QUESTIONS**



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## ISA – Chemistry 1 – Testing Concrete

### Marking Guidelines

#### Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

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### Section 1

---

- |           |  |        |
|-----------|--|--------|
| <b>1</b>  | Purpose of investigation clearly stated  | 1 mark |
|           | Independent variable stated  | 1 mark |
|           | Dependent variable described   | 1 mark |
|           | Quality of written communication for correct usage of two scientific terms<br>eg independent, . Dependent, variable, concentration, volume                           | 1 mark |
|           | Underline each term correctly used. Once three have been underlined, tick the icon.  |        |
| <b>2</b>  | Description to include correct use of measuring device   | 1 mark |
| <b>3</b>  | Identification of a control variable used to make concrete   | 1 mark |
| <b>4</b>  | Any realistic observation eg they did/didn't break in the same place   | 1 mark |
| <b>5</b>  | More reliable  | 1 mark |
| <b>6</b>  | Any suggestion that would make the investigation more likely to test<br>the prediction eg controlling the amount of/excluding air; making<br>all slabs the same size | 1 mark |
| <b>7</b>  | The answer should identify a particular difficulty they had in<br>following instructions ie not a fault in the design  | 1 mark |
| <b>8</b>  | Correct result(s) identified / none needed   | 1 mark |
| <b>9</b>  | Identifies an individual result or a set of results that do not fit the overall pattern<br><b>or</b> Correctly states why none need to be repeated                   | 1 mark |
| <b>10</b> | Describes the pattern/or lack of pattern in the results  | 1 mark |
| <b>11</b> | Correct conclusion that relates to the prediction and fits the data  | 1 mark |
| <b>12</b> | Suitable table of results with all relevant data included  | 1 mark |
|           | Columns and rows correctly labelled  | 1 mark |
|           | Units present and correct  | 1 mark |
|           | Correct choice of bar chart or graph   | 1 mark |
|           | Suitable scales chosen and labelled  | 1 mark |
|           | Correct plotting   | 1 mark |

**Max 20 marks**

---

## Section 2

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- |           |   |        |
|-----------|---|--------|
| <b>13</b> | 35.0 entered into table   | 1 mark |
| <b>14</b> | continuous  | 1 mark |
| <b>15</b> | (a) 'Yes but' or 'No'<br>Explains why there is a lack of confidence in the results<br>eg there are many results below 35; there is a pattern of weakness;<br>areas of the drive are weak etc. | 1 mark |
|           | (b) Words to the effect that the company has a vested interest<br>in its response.  | 1 mark |
|           | (c) Idea of cross checking results; second opinion;<br>independent opinion  | 1 mark |
| <b>16</b> | Must describe the relationship accurately eg concrete generally weaker<br>further from the road, appears to be three batches of concrete.   | 1 mark |
| <b>17</b> | Line graph  | 1 mark |
| <b>18</b> | 32.7 encircled  | 1 mark |
| <b>19</b> | 30 Litres/m <sup>3</sup>  | 1 mark |
| <b>20</b> | Force applied to crush the concrete; strength of concrete   | 1 mark |
| <b>21</b> | Any acceptable uncontrolled variable; human error   | 1 mark |
| <b>22</b> | No. The scale did not allow accurate readings to 0.1 N/mm <sup>2</sup>  | 1 mark |
| <b>23</b> | That parts of the drive had concrete that was mixed with too much water   | 1 mark |
| <b>24</b> | The results for each extra test that used water should exclude any<br>anomalous results in finding the mean   | 1 mark |

**Max 14 marks**

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**Teachers' Notes**  
**ISA – Chemistry 1 – Saturation of Oils**  
**Specimen Material**

This ISA relates to: Chemistry 1

This work should be carried out during the teaching of the section relating to the saturation and uses of oils.

As with all practical investigations, a risk assessment must be carried out prior to their use, but your attention is drawn to the toxic and corrosive nature of bromine water. Suitable precautions must be taken to ensure the safe use of this solution.

Ethanol and oils are flammable, so care must also be taken with these. There should be no flames in the lab.

A suggested method is described below.

- 1 Set up a burette containing bromine water. This could be set up for candidates if appropriate.
- 2 Put 1 cm<sup>3</sup> of ethanol in a boiling tube.
- 3 Add five drops of the oil being tested to the test tube.
- 4 Add 5 cm<sup>3</sup> of the bromine water from the burette.
- 5 Stopper the test tube and shake it.
- 6 If the bromine water is decolourised, add another 5 cm<sup>3</sup> of bromine water, stopper and shake.
- 7 Keep doing this until the bromine water is no longer decolourised.
- 8 Record the volume of bromine water needed in your table.

Candidates should be aware of what use the bromine water has in determining the degree of saturation/unsaturation of oils. Candidates should also be aware of the uses of the oils chosen.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA.

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.

**GCSE Science – Investigative Skills Assignment**  
**Chemistry 1 – Saturation of Oils**  
**Specimen Material**

Centre number						Candidate number					Today's date	.../.../...
Candidate name (please print)											Are your own results submitted with this ISA?	YES/NO (delete one)

**Instructions**

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		<b>Section 1</b>	
		<b>Section 2</b>	
		<b>Total</b> (max 34)	

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

### Section 1

These questions refer to **your own investigation** into the saturation of oils. You should use your own results, your graph/s and what you remember about doing your investigation to answer these questions.

All answers should be in the spaces provided.

- 1 Describe clearly what you were trying to find out in your investigation. Identify your dependent and independent variables.

*Quality of written communication is important in this answer.*

I was trying to find out .....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

- 2 The different oils that you used, can best be described as:  
Tick the box beside the correct answer.

- A categoric variable
- An ordered variable
- A discrete variable
- A continuous variable

(1 mark)

- 3 In order to make it a fair test, you needed to control some **key variables**. Name the key variables that you needed to control.

.....

.....

(2 marks)

- 4 You used bromine water as an indicator. What was the relationship between the amount of bromine water added and the amount of saturation in the oil?

.....  
.....  
(1 mark)

- 5 Why did you repeat your readings three times?

.....  
.....  
(1 mark)

- 6 (a) Why was there some variation in the results?

.....  
(1 mark)

- (b) What type of error caused this variation?

.....  
(1 mark)

- 7 You want to improve either the accuracy or precision of your investigation.

- (a) Suggest **one** change you could make in how you used your apparatus.

.....  
.....  
(1 mark)

- (b) Suggest **one** change you could make in your method.

.....  
.....  
(1 mark)

- 8 Look back to Question 1 where you wrote down what you were trying to find out.

- (a) Now write down what you **did** find out from this investigation.

.....  
.....  
(1 mark)

(b) What conclusion can you make about the saturation levels of the different oils you have used?

.....  
.....

*(1 mark)*

(c) Would it be fair to extend this conclusion to other oils that you have not tested? Explain your answer.

.....  
.....

*(1 mark)*

**9** Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

*(6 marks)*



## Section 2

These questions relate to an investigation that is similar to the one you carried out. You should use the results below as well as your own understanding of how these investigations are carried out, to answer the questions.

A food company tested its own products to make sure that the information on the labels was accurate. It used a test similar to the one you used. They tested bottles taken from the production line and then compared their results with the concentrations stated on the labels of those products. The results are given in the table below. Study the table carefully and then answer the questions that follow.

Name of food	Volume of bromine water added (cm <sup>3</sup> )				Rank order	Concentration on the label (%)
	Test 1	Test 2	Test 3	Average		
Olio	14	13	16	14.3		35
Solio	25	17	27			65
Creamio	17	18	15	16.7		42
Tournesso	3	6	4	4.3		10
Vegeo	10	9	7	8.7		23

- 10 Explain how the company decided which three bottles it would select from the production line for the test.

.....  
 .....  
(1 mark)

- 11 What is the range for the concentrations of unsaturated oils listed on the labels?

.....  
(1 mark)

- 12 Calculate the average amount of bromine water needed to decolourise the Solio product. Write this into the table.

(2 marks)

- 13 Complete the rank order section of the table. Write **1** for the product with the **most** unsaturated oils on the label and **5** for the product with the **least** unsaturated oils.

(1 mark)

- 14 Are there any anomalous results in the table? Answer yes or no

.....  
 If you answered yes, then on the table put a circle around any result that is anomalous.  
(1 mark)

**15** The company wants to display the average results for the amount of bromine water used. What would be the best way to do this?  
Tick the box beside the correct answer.

- Bar chart
- Line graph
- Pie chart
- Scatter graph

*(1 mark)*

**16** 20 000 bottles a day come off the production line. The sample size was only 3 bottles a week. The company was criticised for using a sample size that was too small. Suggest a way of finding out what would be a sensible sample size.

.....  
.....

*(1 mark)*

**17** You want to compare the results of the scientists with those printed on the labels. What would be the best way of doing this?  
Tick the box beside the correct answer.

- A bar chart to show both sets of results
- A line graph joined dot to dot
- A pie chart printed in different colours
- A scatter graph with a line of best fit

*(1 mark)*

**18** The owners of the company said that they were delighted with the results of the investigation. The scientists were not too sure.

The scientists explained that the products were different colours and this might have affected the results. Use their results to explain why the scientists felt that this was a problem.

.....  
.....  
.....

*(1 mark)*

- 19** Describe **one** way in which the knowledge of the amount of unsaturated oils in a food can be useful to a consumer.

.....  
.....

*(1 mark)*

- 20** A consumer suggested that this type of research should not be carried out by the company that manufactures the oils, but should be done by an independent group of scientists. Explain why this point of view is important.

.....  
.....

*(1 mark)*

12
----

**END OF QUESTIONS**

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## ISA – Chemistry 1 – Saturation of Oils

### Marking Guidelines

#### Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

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### Section 1

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- |          |  |         |
|----------|--|---------|
| <b>1</b> | Correct linkage of ‘type of oil’ to ‘saturation’ or ‘unsaturation’   | 1 mark  |
|          | Type of oil  | 1 mark  |
|          | Amount of bromine water added  | 1 mark  |
|          | Quality of written communication for correct use of terminology eg independent, dependent, variable, saturation, unsaturation.   | 1 mark  |
|          | Underline each term correctly used. Once three have been underlined, tick the icon.  |         |
| <b>2</b> | A categoric variable   | 1 mark  |
| <b>3</b> | If one of the following is listed then (1 mark only)<br><b>or</b> if at least three are listed then 1 extra mark<br>eg concentration of bromine<br>water, amount of oil added, amount of ethanol added,<br>same end point, concentration of ethanol, amount of shaking | 2 marks |
| <b>4</b> | The more bromine water that has to be added the less the saturation of the oil   | 1 mark  |
| <b>5</b> | Recognises a lack of precision in the technique (does not need to say why)   | 1 mark  |
| <b>6</b> | (a) Any reasonable statement allowed - most likely being that it is not always clear when the mixture is not decolourised  | 1 mark  |
|          | (b) Correctly links answer in (a) to it being either a random or systematic error  | 1 mark  |
| <b>7</b> | (a) Improvement to the use of the apparatus eg being more careful with the burette to get the correct amount of bromine water into the boiling tube or being more careful with the end point   | 1 mark  |
|          | (b) Improvement to the method e.g. using 1 cm <sup>3</sup> of bromine water at a time or using a white card to show up the bromine water or using a photoelectric device to measure the degree of colourisation  | 1 mark  |

- 
- 8 (a) eg different oils use up different amounts of bromine water or have different amounts of saturation/unsaturation 1 mark
- (b) eg different oils have different concentrations/amounts of unsaturated molecules 1 mark
- (c) Recognition that the results are limited to those oils that have been tested 1 mark
- 9 Table of results showing some of the oils and final quantities of bromine water added (possibly with minor errors), but able to be used for a conclusion 1 mark
- Table shows start and finish values for bromine water, as well as final quantity added 1 mark
- All headings and units correct, no omissions 1 mark
- Correct choice of bar chart 1 mark
- Suitable scales chosen and labelled 1 mark
- Correct plotting 1 mark

**Max 22 marks**

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## Section 2

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- 10 At random or some method for ensuring randomness, idea of a fair sample 1 mark
- 11 10 to 65 % (must include %) 1 mark
- 12 23 gains 1 mark, 26 gains 2 marks 1/2 marks
- 13 Correct order: 3; 1; 2; 5; 4 1 mark
- 14 17 circled for Solio - only 1 mark
- 15 Bar chart 1 mark
- 16 Carry out as many tests as possible until there is consistency, reproducibility, until the range does not increase, or until the average is consistent 1 mark
- 17 Scatter graph with line of best fit 1 mark
- 18 Idea that evidence produced some varied results; there was some overlap in some of the results; any description of the results that illustrates a lack of confidence in the results 1 mark
- 29 Any correct appreciation of its importance in the diet or in industry 1 mark
- 20 Any suggestion about mistrust of the findings eg suggestion that consumers might believe that there could be some influence to produce results that the company and/or the scientists would want to see, rather than the accurate results 1 mark

**Max 12 marks**

**Teachers' Notes**  
**ISA – Chemistry 2 – Reaction of Limestone Rates**  
**Specimen Material**

This ISA relates to: Chemistry 2

**What factors affect the rate at which limestone reacts with acids?**

Candidates should be given the opportunity to carry out an investigation into the above problem. They may choose any independent variable to investigate and any method of doing so.

Instructions of a general nature may be given, but these must not be so prescriptive as to not allow the candidate to make any decisions for him or herself.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA.

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.

**GCSE Science – Investigative Skills Assignment  
Chemistry 2 – Reaction of Limestone Rates  
Specimen Material**

Centre number						Candidate number					Today's date	.../.../...
Candidate name (please print)						Are your own results submitted with this ISA?					YES/NO (delete one)	

**Instructions**

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		Section 1	
Section 2			
Total (max 34)			

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

## Section 1

These questions refer to **your own investigation** into the reaction of limestone. You should use your own results, your graph/s and what you remember about doing your investigation to answer these questions. All answers should be in the spaces provided.

- 1 What were you trying to find out in your investigation?  
Complete the blank spaces in the sentence below.

I was trying to find out if the.....  
..... depends on the  
.....  
(2 marks)

- 2 Name one variable that you kept the same.

.....  
.....  
(1 mark)

- 3 Describe how you controlled this variable.

.....  
.....  
(1 mark)

- 4 Did you need to repeat any of your readings?  
Answer yes or no and give the reason why.

.....  
.....  
(1 mark)

- 5 Write down **one** thing that you measured during your investigation.

One thing that I measured was the .....

What piece of equipment did you choose to make this measurement?

I used .....

- (a) What else could you have used instead of the equipment that you chose?

.....  
(1 mark)



(b) Write down **one** reason why the equipment that you chose was a better choice than the alternative.

.....  
(1 mark)

6 Put a circle around any data that did not seem to fit your pattern. You can do this on your table or your graph. If you did not find any anomalous results then say so here.

.....  
.....  
(1 mark)

7 Were there any random errors in your results? Answer yes or no and use an example to support your answer and suggest why it happened.

.....  
.....  
(1 mark)

8 Is there a pattern in your results? Answer yes or no and explain your answer.

.....  
.....  
(1 mark)

9 Do you think that you have enough data to make a conclusion? Answer yes or no and explain your answer.

.....  
.....  
.....  
(1 mark)

10 Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

(6 marks)

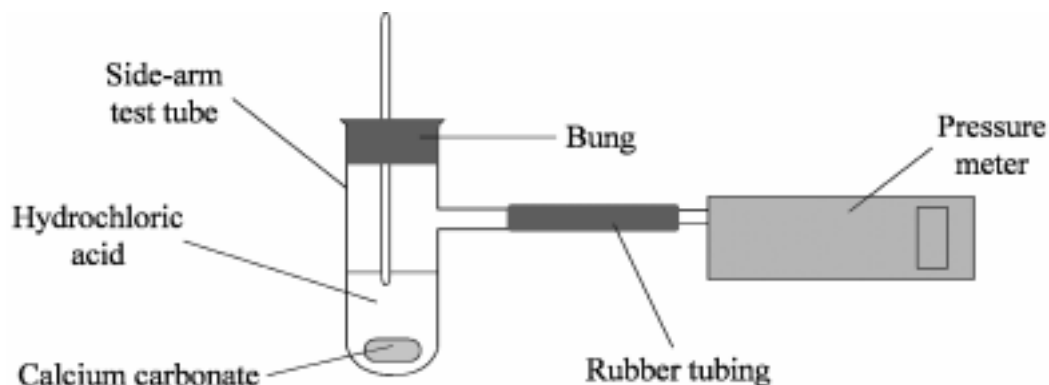
**Turn over for the next question**

## Section 2

These questions are about **Arpita's investigation** into the reaction between hydrochloric acid and calcium carbonate (limestone). You should use her results below, as well as your own understanding of how these investigations are carried out, to answer the questions.

Arpita wanted to find out if the **rate** of reaction depended upon the **concentration** of the acid.

She used 5 different concentrations of acid, and measured the maximum pressure of the carbon dioxide gas produced, using the apparatus shown below.



She made sure that she weighed out exactly the same mass of calcium carbonate for each investigation. She also monitored the temperature of the acid.

She then calculated the **rate** of gas pressure change and showed her results in the table below.

**Table 1**

Molarity (M)	Rate (kPa/s) <sup>-1</sup>	Acid Temperature (°C)	
		Before	After
<b>1<sup>st</sup> Test</b>			
0.2	0.048	28	30
0.4	0.170	28	29
0.5	0.200	27	29
0.6	0.530	27	34
0.8	0.340	27	28
<b>2<sup>nd</sup> Test</b>			
0.2	0.041	22	25
0.4	0.160	22	24
0.5	0.180	22	25
0.6	0.290	24	26
0.8	0.380	24	26
<b>3<sup>rd</sup> Test</b>			
0.2	0.022	23	26
0.4	0.079	23	25
0.5	0.220	25	26
0.6	0.240	25	27
0.8	0.260	24	26

11 Write down **one** way in which Arpita made this a fair test.

.....  
(1 mark)

12 Arpita carried out the investigation 3 times for each concentration.  
Why did she do this?

.....  
.....  
(1 mark)

13 Arpita measured the temperature of the acid before and after the reaction.

(a) Why did she do this?

.....  
(1 mark)

(b) What sort of a variable was the temperature in Arpita's investigation?  
Tick the box beside the correct answer.

A categoric variable

A continuous variable

A dependent variable

A discrete variable

(1 mark)

14 Arpita next worked out the average of all three tests.

**Table 2**

Averages of results from all three tests	
Molarity (M)	Rate (kPa/s) <sup>-1</sup>
0.2	0.037
0.4	0.136
0.5	
0.6	0.353
0.8	0.326

Work out the average rate for 0.5 M and put the figure in the table.

(1 mark)

**15** There appears to be an anomalous result in Table 1.

(a) Put a circle around this result.

(1 mark)

(b) Suggest **one** reason why this result was anomalous.

.....  
(1 mark)

(c) What should Arpita have done with this result when calculating the averages?

.....  
(1 mark)

(d) Do you think that this error was a **random** error or a **systematic** error?  
Explain your answer.

I think it was a ..... error because .....

.....  
(1 mark)

(e) Arpita calculated her averages to 3 significant figures.

Do you think this was the right thing to do?

Tick the box beside the correct answer.

No, because her original results were only to 2 significant figures

No, because her calculator would have shown more significant figures

Yes, because averages are always shown to 3 significant figures

Yes, because she averaged 3 sets of results

(1 mark)

**16** What would be the best way for Arpita to show her average results graphically?

Tick the box beside the correct answer.

Bar chart

Line graph

Pie chart

Scatter graph

(1 mark)



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## ISA – Chemistry 2 – Reaction of Limestone Rates

### Marking Guidelines

#### Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

---

### Section 1

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<b>1</b>	Dependent variable correctly named	1 mark
	Independent variable correctly named	1 mark
<b>2</b>	Correct control variable, eg temperature, concentration	1 mark
<b>3</b>	eg water bath for temperature	1 mark
<b>4</b>	No mark for yes or no, mark is for correct reason, eg no, because the pattern seemed consistent, or yes, because I obtained an anomalous result	1 mark
<b>5</b>	No marks for stating what was measured, or the instrument used	
	(a) sensible alternative suggested	1 mark
	(b) reason given, e.g. better precision/ accuracy	1 mark
<b>6</b>	Either anomalous result correctly identified, or correct statement that there are no anomalous results	1 mark
<b>7</b>	Either Yes if correct, with reason, or No, if correct, with reason	1 mark
<b>8</b>	Either Yes if correct, with reason, or No, if correct, with reason	1 mark
<b>9</b>	Either Yes if correct, with reason, or No, if correct, with reason	1 mark
<b>10</b>	Suitable table of results with all relevant data included	1 mark
	Columns and rows correctly labelled	1 mark
	Units present and correct	1 mark
	Choice of bar chart or graph	1 mark
	Suitable scales chosen and labelled	1 mark
	Correct plotting	1 mark

**Max 17 marks**

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## Section 2

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- 11 Any valid, eg same mass of limestone 1 mark
- 12 Idea of acting as a cross check or alternatives 1 mark
- 13 (a) Idea of monitoring 1 mark  
(b) A continuous variable 1 mark
- 14 0.248 1 mark
- 15 (a) circle around 0.240 for 0.6M in third test 1 mark  
(b) pressure less due to leakage of gas 1 mark  
(c) Arpita should have ignored this result and just averaged the other two 1 mark  
(d) random, because it is the only one that does not fit a pattern 1 mark  
(e) no, because her original results were only to 2 significant figures 1 mark
- 16 Line graph 1 mark
- 17 Idea of increased reliability 1 mark
- 18 Arpan is right – it is an opinion 1 mark  
only one kind of acid tested 1 mark  
cannot generalise from a single test 1 mark  
Quality of written communication - 1 mark  
correct use of any **three** technical terms,  
eg opinion; generalise; evidence; conclusion.  
Underline each term correctly used.  
Once three have been underlined, tick the icon.
- 19 Idea that increased concentrations will speed up rate of erosion/decay of buildings 1 mark

**Max 17 marks**

**Teachers' Notes**  
**ISA – Chemistry 3 – Hardness of Water**  
**Specimen Material**

This ISA relates to: Chemistry 3

**What is in the water we drink?**

Candidates should be given the opportunity to carry out an investigation into the hardness of water. They may choose any method of doing so, and may investigate either permanent or temporary hardness, or may choose to investigate water softeners.

A suggested approach would be to supply the candidates with a selection of different samples of water containing differing degrees of hardness and ask them to compare them.

Instructions of a general nature may be given, but these must not be so prescriptive as to not allow the candidate to make any decisions for him or herself. However the investigation is carried out, it should include a **control** investigation. For example, if investigating different samples of water for hardness, they should compare this with a sample of distilled water.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA.

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.



**GCSE Science – Investigative Skills Assignment  
Chemistry 3 – Hardness of Water  
Specimen Material**

Centre number						Candidate number					Today's date	.../.../...
Candidate name (please print)											Are your own results submitted with this ISA?	YES/NO (delete one)

**Instructions**

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		Section 1	
		Total (max 34)	

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

## Section 1

These questions refer to **your own investigation** into the hardness of water. You should use your own results, and graph/s and what you remember about doing your investigation to answer these questions.

All answers should be in the spaces provided.

1 What were you trying to find out in your investigation?

.....  
.....  
.....

*(1 mark)*

2 Name **one** variable that you kept the same.

.....

*(1 mark)*

3 Describe how you controlled this variable.

.....  
.....

*(1 mark)*

4 In your investigation, you deliberately changed one variable (the independent variable) to find out how this altered another variable (the dependent variable).

(a) In your investigation, what was the **independent** variable?

.....

*(1 mark)*

(b) What kind of a variable was this?

Tick the box beside the correct answer.

A continuous variable

A discrete variable

A ordered variable

A ranked variable

*(1 mark)*

5 Your investigation included a control investigation.

(a) What is the purpose of a control investigation?

.....  
.....  
*(1 mark)*

(b) Describe what you did in your control investigation.

.....  
.....  
*(1 mark)*

6 Did you need to repeat any of your readings? Answer yes or no and explain why.

.....  
.....  
*(1 mark)*

7 Put a circle around any data that did not seem to fit your pattern.  
You can do this on your table or your graph.  
If you did not find any anomalous results then say so here.

.....  
.....  
*(1 mark)*

8 Were there any random errors in your results? Answer yes or no.

.....  
  
If you answered yes, say which ones they were.  
If you answered no, say how you know this.  
  
.....  
.....  
*(1 mark)*

9 Is there a pattern in your results?  
Answer yes or no and then explain your answer by describing your graph.

.....  
.....  
*(1 mark)*

- 10** Do you think that you have enough data to make a conclusion?  
Answer yes or no and explain your answer.

.....  
.....  
*(1 mark)*

- 11** Suggest **one** improvement that you could make in your investigation if you had to carry it out again.

.....  
.....  
*(1 mark)*

- 12** Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

*(6 marks)*

## Section 2

These questions are about water softening. You should use the results below, as well as your own understanding of how these investigations are carried out, to answer the questions.

Mrs Jones was concerned that the water supplied by her Water Company was very hard. She used the Internet to find the following information.

### Hardness of water

This is mainly caused by salts of calcium and magnesium and can be of two types.


**Temporary hardness** is usually caused by hydrogencarbonates and can be removed by boiling the water.

**Permanent hardness** is usually caused by sulphates and cannot be removed by boiling.

**Soft to moderately soft**  
0 to 100 mg/l of calcium carbonate equivalent

**Slightly hard to moderately hard**  
100 to 200 mg/l of calcium carbonate equivalent

**Hard to very hard**  
Above 200 mg/l of calcium carbonate equivalent

Click here to see a map of the UK showing what the water is like in your area.   
Remember that there can be local variations.

She clicked on the map, and it appeared to show that she lived in a ‘Soft to moderately soft’ area.

- 13 How can you explain the fact that her water was hard and yet according to the map she lived in an area where the water was soft?

.....  
.....  
(1 mark)

- 14 Mr and Mrs Jones had different opinions about the water. Mrs Jones said, ‘The water must be hard because it takes a lot of soap to produce lather’. Mr Jones said, ‘I don’t think it is hard, because there is no fur or scale in the kettle.’  
What scientific evidence would be needed to decide who was right?

.....  
.....  
(1 mark)

Mrs Jones telephoned the Water Company and they agreed to take a sample of her water to analyse. The scientists who arrived to do this first of all opened the taps to let several litres of water flush through the pipes. They then took three samples: one from the kitchen tap, one from the bathroom tap, and one from the garden tap.

- 15 Suggest **one** reason why they allowed a large amount of water to run through the pipes before taking a sample.

.....  
 .....  
 (1 mark)

- 16 Why did they take three samples, rather than just one?

.....  
 .....  
 (1 mark)

Here are the results of the tests they carried out.

<b>Test results for Mrs Jones</b>		
We have tested each of the samples using two different methods, and the average results are shown below.		
<b>Site of sample</b>	<b>Total hardness (mg/l Calcium Carbonate equivalent)</b>	<b>Average total hardness</b>
Kitchen tap	93	
Bathroom tap	101	
Garden tap	103	
Your water is soft and you do not need to treat it in any way.		

- 17 Why did they use two different methods of testing?  
 Tick the box beside the correct answer.

- To make the results more accurate
- To make the results more precise
- To make the results more reliable
- To make the results more valid

(1 mark)

- 18 Fill in the table to show the average total hardness.

(1 mark)

- 19 Using the figure you worked out in Question 18 and the chart that Mrs Jones found on the Internet, describe the hardness of her water.

.....

.....

(1 mark)

- 20 What would be the best way to show the Water Company's results graphically?  
Tick the box beside the correct answer.

Bar chart

Line graph

Pie chart

Scatter graph

(1 mark)

Mrs Jones decided she would get a second opinion. She asked a company that specialises in water treatment to test the water for her. They came and took one sample of water from her garden tap. Here is part of their report.

**Watersoft Ltd.**

*Report to Mrs Jones on water supply:*

We have found that your water supply has a hardness of 100 mg/l of calcium carbonate equivalent ( $\pm 10\%$ ) and this means that your water is hard.

We recommend that you purchase one of our Deluxe Water Softeners. The current price of these is . . .

- 21 What is the advantage of obtaining a second opinion?

.....

.....

(1 mark)

- 22 What is the meaning of the term  $\pm 10\%$  that appears on the report?  
Tick the box beside the correct answer.

It is a way of showing an uncertainty in the results

It means that only 10% of the water tested was hard

It means that the water is definitely hard

It shows that other chemicals besides calcium carbonate were present

(1 mark)

**23** Do you think that ‘Watersoft’ came to a fair conclusion in recommending that Mrs. Jones purchase a water softener?  
 Answer by explaining whether you think that the results of the ‘Watersoft’ investigations agree or disagree with those of the Water Board, and which test results you have more confidence in.

*Quality of written communication is important in this answer.*

.....

.....

.....

.....

.....

*(4 marks)*

**24** Suggest **one** reason why the Water Board and ‘Watersoft Ltd.’ made different recommendations to Mrs Jones.

.....

.....

*(1 mark)*



**END OF QUESTIONS**



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## Marking Guidelines

### ISA – Chemistry 3 – Hardness of Water

#### Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

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#### Section 1

---

- |           |  |        |
|-----------|--|--------|
| <b>1</b>  | Correctly states the purpose of the investigation  | 1 mark |
| <b>2</b>  | Correct control variable, eg temperature, volume of soap solution  | 1 mark |
| <b>3</b>  | eg water bath for temperature/measuring cylinder for volume of water   | 1 mark |
| <b>4</b>  | (a) Input variable correctly identified, eg different type of water, or quantity of softener added   | 1 mark |
|           | (b) Answer will depend upon nature of the investigation, eg categoric if comparing samples from different places                                       | 1 mark |
| <b>5</b>  | (a) Idea of being able to make comparison or ‘to see what the difference is’   | 1 mark |
|           | (b) Control explained, eg using distilled water as a comparison, or adding no softener   | 1 mark |
| <b>6</b>  | No mark for yes or no, mark is for correct reason, eg no, because the pattern seemed consistent, <b>or</b> yes, because I obtained an anomalous result | 1 mark |
| <b>7</b>  | Either anomalous result correctly identified, <b>or</b> correct statement that there are no anomalous results  | 1 mark |
| <b>8</b>  | Either yes if correct, with reason, <b>or</b> no, if correct, with reason  | 1 mark |
| <b>9</b>  | Either yes if correct, with reason, <b>or</b> no, if correct, with reason  | 1 mark |
| <b>10</b> | Either yes if correct, with reason, <b>or</b> no, if correct, with reason  | 1 mark |
| <b>11</b> | Any suitable improvement suggested   | 1 mark |

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<b>12</b>	Suitable table of results with all relevant data included	1 mark
	Columns and rows correctly labelled	1 mark
	Units present and correct	1 mark
	Correct choice of bar chart or graph	1 mark
	Suitable scales chosen and labelled	1 mark
	Correct plotting	1 mark

**Max 19 marks**

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## Section 2

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<b>13</b>	Idea of local variations	1 mark
<b>14</b>	Chemical tests to see whether carbonates or sulphates are present	1 mark
<b>15</b>	Idea of obtaining a fair sample	1 mark
<b>16</b>	Idea of benefit of repeated readings (eg to improve accuracy)	1 mark
<b>17</b>	To make the results more reliable	1 mark
<b>18</b>	99	1 mark
<b>19</b>	Soft to moderately soft	1 mark
<b>20</b>	Bar chart	1 mark
<b>21</b>	Idea that it provides extra evidence or conclusions may be more reliable with more data	1 mark
<b>22</b>	It is a way of showing an uncertainty in the results	1 mark
<b>23</b>	Results agree – both on the borderline between soft and moderately hard	1 mark
	Water Board, tests are more reliable	1 mark
	Reason for greater reliability, eg more samples taken/two different methods used	1 mark
	Quality of written communication - correct use of any <b>three</b> technical terms, eg reliable/reliability; sample/sampling; uncertainty; variation.	1 mark
	Underline each term correctly used.	
	Once three have been underlined, tick the icon.	
<b>24</b>	Idea that they want her to spend money with them on a water softener.	1 mark

**Max 15 marks**