

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Foundation Tier and Higher Tier
March 2012

Science A
Unit Chemistry C1b (Oils, Earth and Atmosphere)
Chemistry
Unit Chemistry C1b (Oils, Earth and Atmosphere)

CHY1BP
F&H

Thursday 1 March 2012 Morning Session

For this paper you must have:

- a black ball-point pen
 - an objective test answer sheet.
- You may use a calculator.

Time allowed

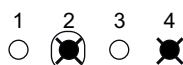
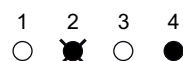
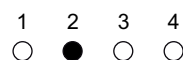
- 30 minutes

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 'Chemistry Unit 1b' 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.
- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown.
- 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.



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 16 of this booklet.

FOUNDATION TIER

Section One

Questions **ONE** to **FIVE**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

This question is about food additives.

Each type of additive changes a food in some way.

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

- A** colouring
- B** emulsifier
- C** preservative
- D** sweetener

	Reason for using the additive in the food
1	to make water and oil stay mixed together in salad cream
2	to make soft drinks orange, red or purple
3	to replace sugar in diet drinks
4	to increase the shelf-life of the food

QUESTION TWO

This question is about four planets, **A**, **B**, **C** and **D**, in the Solar System.

	Planet	Atmosphere	Average surface temperature in °C
A	Venus	96 % carbon dioxide, 4 % nitrogen	460
B	Earth	78 % nitrogen, 21 % oxygen, 0.96 % noble gases, 0.04 % carbon dioxide	14
C	Mars	97 % carbon dioxide, 2 % nitrogen, 1 % noble gases	-46
D	Jupiter	87 % hydrogen, 13 % helium	-121

Match planets, **A**, **B**, **C** and **D**, with the sentences **1–4** below.

- 1** Its atmosphere has the highest percentage of carbon dioxide.
- 2** It has green plants growing on its surface.
- 3** Its atmosphere consists of only two elements.
- 4** It has the highest average surface temperature.

Turn over for the next question

Turn over ►

QUESTION THREE

The table shows the properties of four polymers, **A**, **B**, **C** and **D**.

Properties	
A	is not damaged at high temperatures and has a non-stick surface
B	is strong, does not rot and can be pulled into fibres
C	makes a very light, solid foam that is a good heat insulator
D	is transparent, waterproof and stays flexible over a wide range of temperatures

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

How the polymer could be used	
1	to make disposable cups for hot drinks
2	to make string and rope
3	to make the coating on frying pans
4	to make bags used to store frozen foods

QUESTION FOUR

The table below shows the masses of some gases produced when one gram of each of the polymers, **A**, **B**, **C** and **D**, is burned in air.

		Combustion products in mg						
	Polymer name	C ₂ H ₄	CH ₄	CO ₂	CO*	NO ₂ *	HCN*	NH ₃ *
A	Acrylic	5	17	1300	170	45	40	3.0
B	Kevlar	0	0	1850	50	10	14	0.5
C	Nylon	50	25	1200	250	20	30	0
D	Polyester	6	10	1000	350	0	0	0

Toxic gases are marked with *.

Match polymers, **A**, **B**, **C** and **D**, with the statements **1–4** below.

- 1** the polymer that produces the most NH₃
- 2** the polymer that produces the most alkene
- 3** the polymer that produces no hydrocarbons
- 4** the polymer that produces the largest total mass of toxic gases

Turn over for the next question

Turn over ►

QUESTION FIVE

Hydrocarbon molecules can be broken down to produce smaller hydrocarbon molecules.

An example is shown below.



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

1	It is the hydrocarbon with the largest molecules.
2	It is the molecule that contains exactly 14 atoms.
3	It is the monomer from which poly(ethene) is made.
4	It is the second hydrocarbon in the alkene series.

Turn over for the next question

Turn over ►

Section Two

Questions **SIX** to **NINE**.

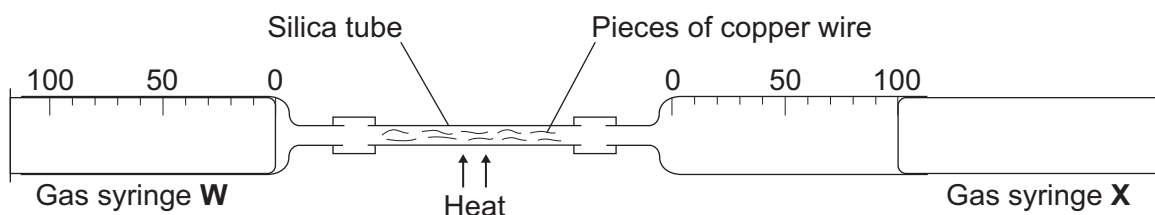
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION SIX

A student used this apparatus to investigate the composition of air.



- The student passed 100 cm³ of dry air from syringe **X** backwards and forwards over heated copper wire inside a silica tube.
- The copper reacted with the oxygen in the dry air.
- After 1 minute, the student pushed all the remaining gas into syringe **X** and allowed the apparatus to cool to room temperature.
- The volume of gas in syringe **X** was then measured and recorded.

The student repeated this procedure seven times for a total of 8 minutes of heating.

The results are given in **Table 1**.

Table 1

Total time of heating in minutes	1	2	3	4	5	6	7	8
Volume of gas in syringe X in cm³	94	89	85	82	80	79	79	79

6A The volume of gas in syringe **X** did not change after a total of 6 minutes of heating.

The student continued the investigation for a further 2 minutes to make sure that . . .

- 1 all the copper had reacted.
- 2 all the water vapour had condensed.
- 3 all the oxygen in the syringes had reacted.
- 4 all the carbon dioxide had reacted.

The student repeated the investigation four times.

The final volume of gas in syringe **X** for each of the five investigations is given in **Table 2**.

Table 2

Investigation	1	2	3	4	5
Final volume of gas in syringe X in cm ³	79	80	78	88	79

6B The student made a random error in one of the investigations.

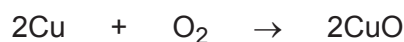
This could have been because . . .

- 1 the student did not allow the apparatus to cool before reading the final volume.
- 2 the student heated the copper wire in the silica tube too strongly.
- 3 there was a leak in the apparatus, allowing some of the gas to escape.
- 4 the student did not push all of the gas into syringe **X** before reading the final volume.

6C From the results in **Table 2**, what is the mean (average) final volume, in cm³, of the gas in syringe **X**?

- 1 78
- 2 79
- 3 80
- 4 88

6D Copper reacts with oxygen to form copper oxide.



In each of the investigations 2 grams of copper were heated in the silica tube.

The mass of copper oxide formed would be . . .

- 1 1 gram.
- 2 less than 2 grams.
- 3 2 grams.
- 4 more than 2 grams.

Turn over ►

QUESTION SEVEN

The table shows some information about five plant oils.

Plant oil	Melting point in °C	Iodine number
Palm	+35	54
Peanut	+3	93
Rapeseed	-5	110
Sunflower	-12	124
Linseed	-24	178

The iodine number is the number of grams of iodine that react with 100 grams of the oil.

7A The data in the table shows that for these plant oils . . .

- 1 as the iodine number increases, the melting point decreases.
- 2 all are liquids at room temperature (20 °C).
- 3 as the iodine number increases, the melting point increases.
- 4 all are solids at room temperature (20 °C).

7B The relationship between melting point and iodine number would be best shown as . . .

- 1 a line graph.
- 2 a bar chart.
- 3 a pie chart.
- 4 a scattergram.

Sunflower oil is a liquid at room temperature. Sunflower spread, made from the oil, is solid at room temperature.

7C This is because the sunflower spread . . .

- 1 contains artificial colourings.
- 2 contains more water.
- 3 has a higher melting point than the oil.
- 4 is more concentrated than the oil.

7D Sunflower oil contains unsaturated compounds.

Unsaturated compounds are different from saturated compounds because they . . .

- 1 are more soluble in water.
- 2 have double carbon carbon bonds in their molecules.
- 3 have lower iodine numbers.
- 4 do not react with hydrogen.

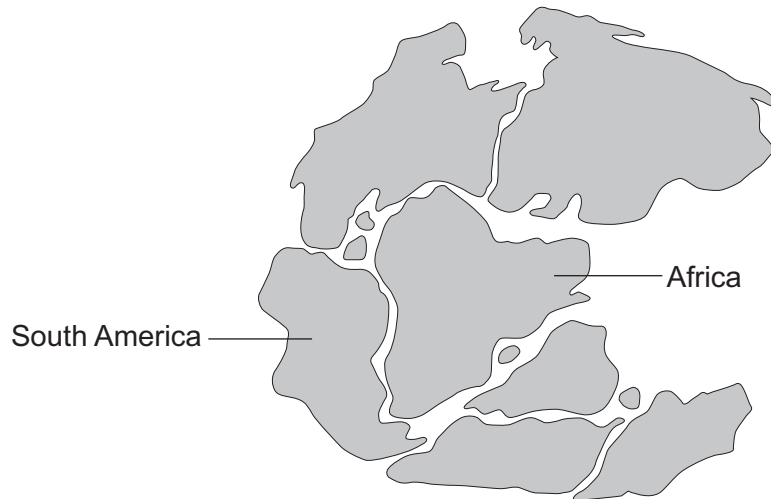
Turn over for the next question

Turn over ►

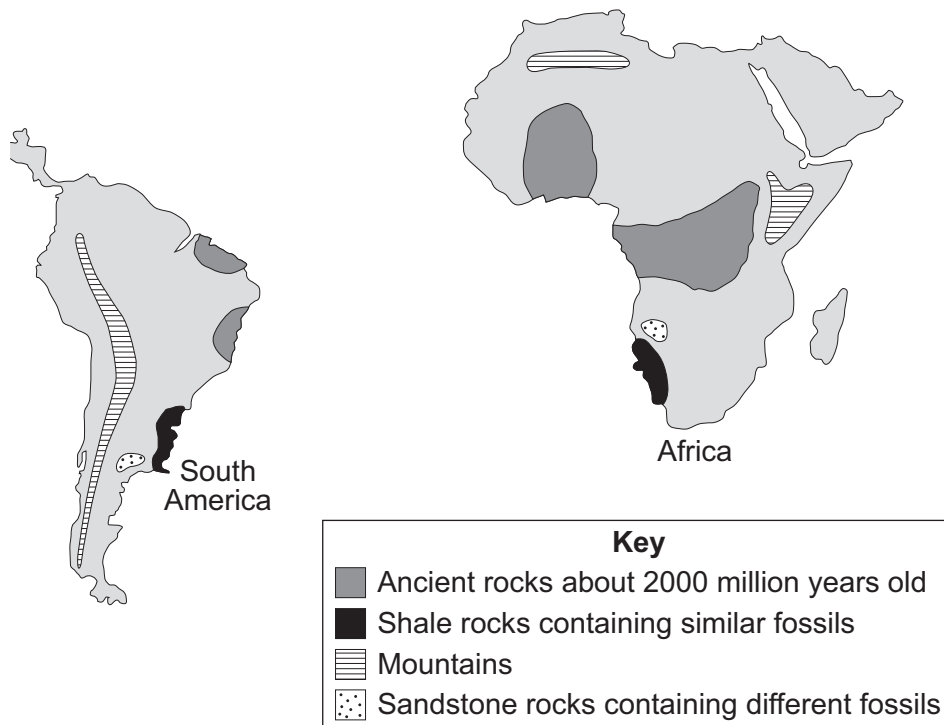
QUESTION EIGHT

The scientist Alfred Wegener studied the continents.

He suggested that all the continents had once been connected and that they drifted apart later on.



Wegener's study of the African and South American continents provided evidence that they had once been connected.



8A One piece of evidence that Wegener observed was that the two continents . . .

- 1 are a short distance apart.
- 2 are of a similar shape and similar size.
- 3 have a similar climate.
- 4 have coastlines that could fit together.

8B Which row in the table correctly shows two more pieces of evidence that Africa and South America were once joined?

1	ancient rocks in matching positions on the two continents	shale rocks containing similar fossils
2	different fossils in sandstone rocks	mountains in matching positions on the two continents
3	different fossils in sandstone rocks	shale rocks containing similar fossils
4	ancient rocks in matching positions on the two continents	mountains in matching positions on the two continents

Wegener's theory was not generally accepted when it was first proposed.

8C Why did many scientists disagree with his theory?

- 1 Animals that live on the two continents are very different.
- 2 The scientists could not explain how the continents moved.
- 3 Some of the rocks on the two continents are different.
- 4 Plants that live on the two continents are very different.

8D Later, most scientists accepted Wegener's theory.

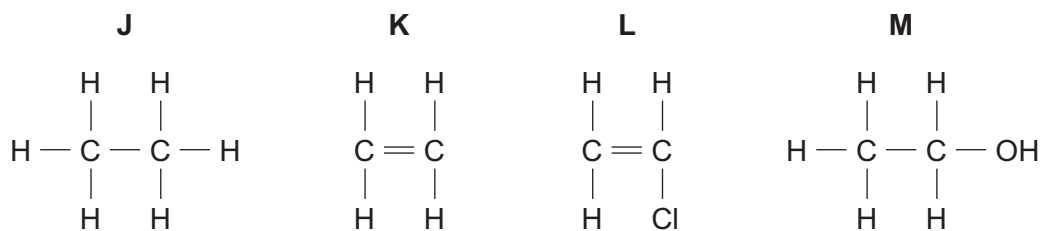
This was because of evidence that . . .

- 1 volcanic activity could cause continents to move.
- 2 the Earth's crust is cooling.
- 3 the Earth's crust is shrinking.
- 4 the Earth's crust is made up of tectonic plates.

Turn over ►

QUESTION NINE

The diagram shows one molecule of each of four compounds, **J**, **K**, **L** and **M**.



9A Which of the compounds are hydrocarbons?

- 1 **J** and **K**
- 2 **K** and **L**
- 3 **L** and **M**
- 4 **J**, **K** and **M**

9B Which row in the table describes the bonding in these four compounds?

	Number of bonds to each carbon atom	Number of bonds to each hydrogen atom
1	1	1
2	1	4
3	4	1
4	4	4

9C Two of the compounds can form polymers because . . .

- 1 their molecules are saturated.
- 2 they are hydrocarbons.
- 3 their molecules have a double carbon carbon bond.
- 4 they are not biodegradable.

9D Compounds **K** and **L** will change bromine water from yellow-brown to colourless because . . .

- 1 their molecules are unsaturated.
- 2 their molecules contain two carbon atoms.
- 3 their molecules contain only carbon atoms and hydrogen atoms.
- 4 their molecules can be cracked.

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 One

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

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

Hydrocarbon molecules can be broken down to produce smaller hydrocarbon molecules.

An example is shown below.



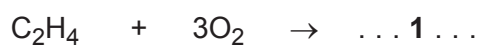
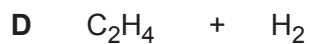
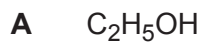
Match molecules, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

1	It is the hydrocarbon with the largest molecules.
2	It is the molecule that contains exactly 14 atoms.
3	It is the monomer from which poly(ethene) is made.
4	It is the second hydrocarbon in the alkene series.

QUESTION TWO

This question is about four chemical reactions.

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



Turn over for the next question

Turn over ►

Section Two

Questions **THREE** to **NINE**.

Each of these questions has four parts.

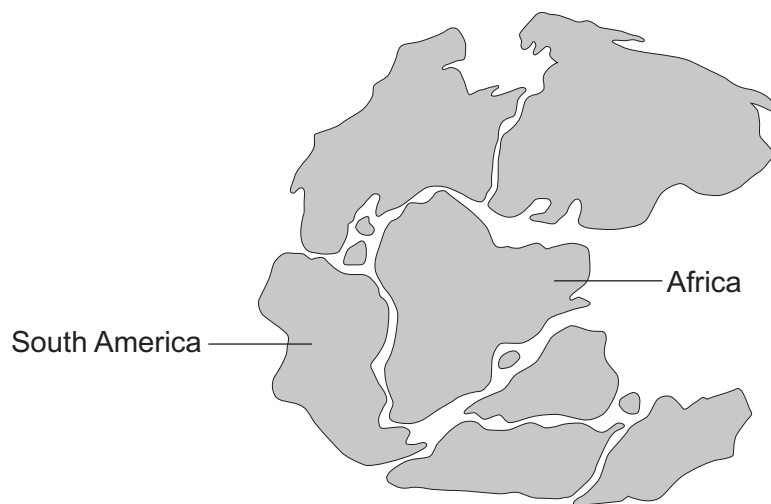
In each part choose only **one** answer.

Mark your choices on the answer sheet.

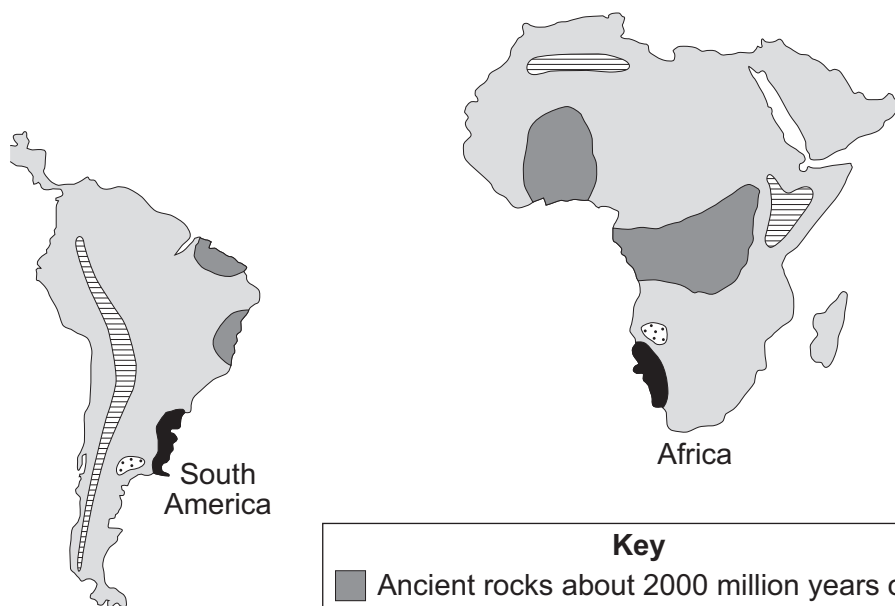
QUESTION THREE





The scientist Alfred Wegener studied the continents.

He suggested that all the continents had once been connected and that they drifted apart later on.



Wegener's study of the African and South American continents provided evidence that they had once been connected.



Key	
	Ancient rocks about 2000 million years old
	Shale rocks containing similar fossils
	Mountains
	Sandstone rocks containing different fossils

3A One piece of evidence that Wegener observed was that the two continents . . .

- 1 are a short distance apart.
- 2 are of a similar shape and similar size.
- 3 have a similar climate.
- 4 have coastlines that could fit together.

3B Which row in the table correctly shows two more pieces of evidence that Africa and South America were once joined?

1	ancient rocks in matching positions on the two continents	shale rocks containing similar fossils
2	different fossils in sandstone rocks	mountains in matching positions on the two continents
3	different fossils in sandstone rocks	shale rocks containing similar fossils
4	ancient rocks in matching positions on the two continents	mountains in matching positions on the two continents

Wegener's theory was not generally accepted when it was first proposed.

3C Why did many scientists disagree with his theory?

- 1 Animals that live on the two continents are very different.
- 2 The scientists could not explain how the continents moved.
- 3 Some of the rocks on the two continents are different.
- 4 Plants that live on the two continents are very different.

3D Later, most scientists accepted Wegener's theory.

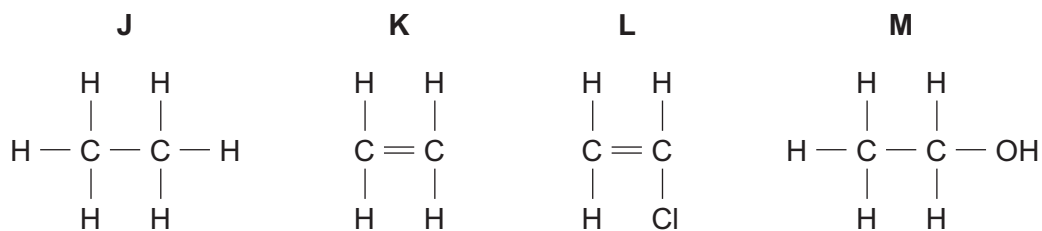
This was because of evidence that . . .

- 1 volcanic activity could cause continents to move.
- 2 the Earth's crust is cooling.
- 3 the Earth's crust is shrinking.
- 4 the Earth's crust is made up of tectonic plates.

Turn over ►

QUESTION FOUR

The diagram shows one molecule of each of four compounds, **J**, **K**, **L** and **M**.



4A Which of the compounds are hydrocarbons?

- 1 **J** and **K**
- 2 **K** and **L**
- 3 **L** and **M**
- 4 **J**, **K** and **M**

4B Which row in the table describes the bonding in these four compounds?

	Number of bonds to each carbon atom	Number of bonds to each hydrogen atom
1	1	1
2	1	4
3	4	1
4	4	4

4C Two of the compounds can form polymers because . . .

- 1 their molecules are saturated.
- 2 they are hydrocarbons.
- 3 their molecules have a double carbon carbon bond.
- 4 they are not biodegradable.

4D Compounds **K** and **L** will change bromine water from yellow-brown to colourless because . . .

- 1 their molecules are unsaturated.
- 2 their molecules contain two carbon atoms.
- 3 their molecules contain only carbon atoms and hydrogen atoms.
- 4 their molecules can be cracked.

Turn over for the next question

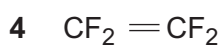
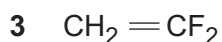
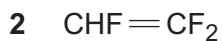
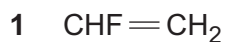
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QUESTION FIVE

In a molecule of ethene, (C_2H_4), one or more of the hydrogen atoms can be replaced by fluorine. Polymers can be made from these monomer molecules that contain fluorine.

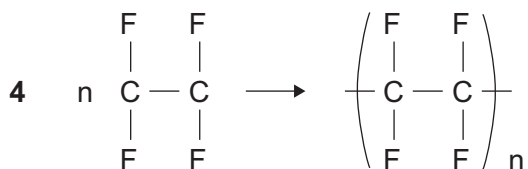
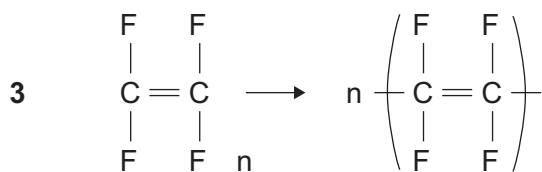
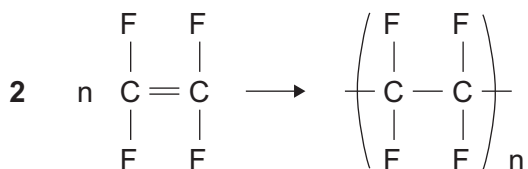
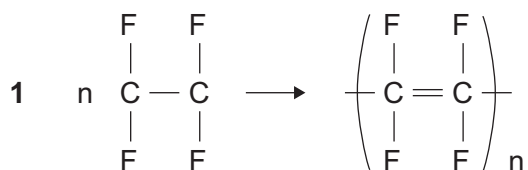
Increasing the number of fluorine atoms makes these polymers less reactive.

5A Which of the following monomers would form the **most** reactive polymer?



The polymer poly(tetrafluoroethene) formed from the monomer $CF_2 = CF_2$ was discovered accidentally in 1938.

5B Which equation represents the polymerisation of this monomer?



5C Poly(tetrafluoroethene) is a thermosoftening polymer.

This means that this polymer . . .

- 1 softens when first heated, then hardens, but cannot afterwards be remoulded.
- 2 can be repeatedly softened by heating and remoulded.
- 3 contains only small molecules that are rearranged on heating.
- 4 has weak bonds between the long molecules which become stronger on heating.

5D Pipes to carry corrosive hydrofluoric acid can be made from poly(tetrafluoroethene).

This suggests that this polymer . . .

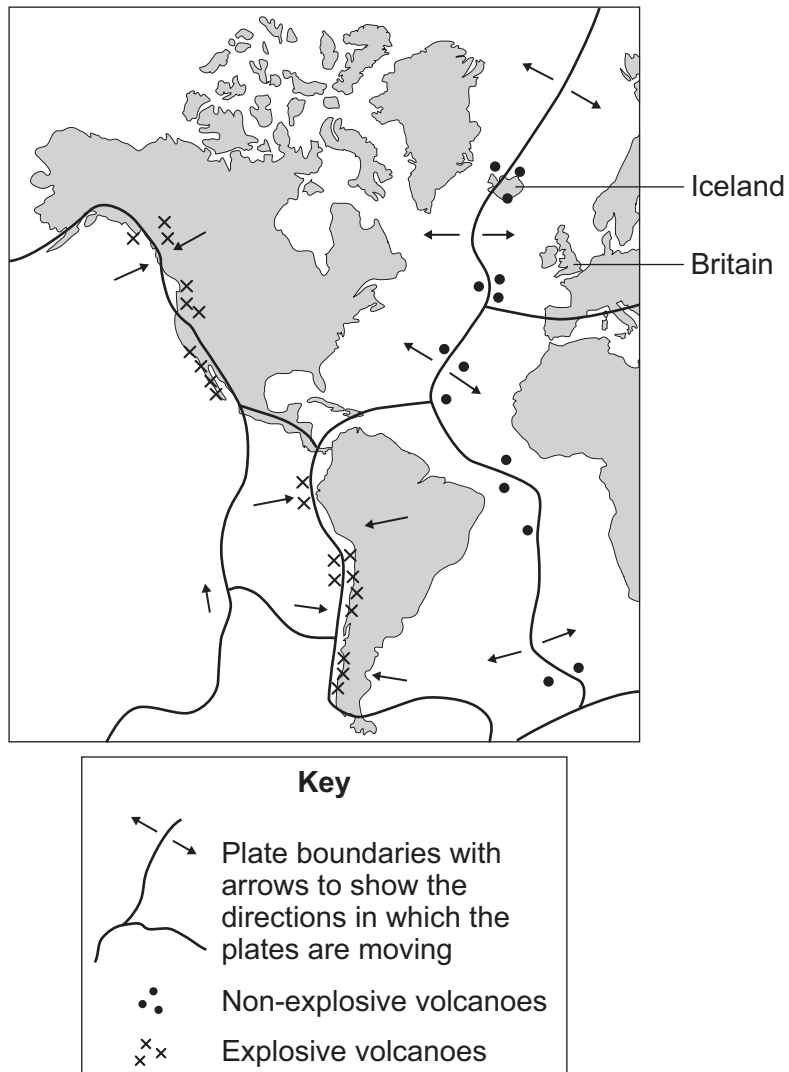
- 1 is a good lubricant.
- 2 does not dissolve in any solvent.
- 3 is unreactive.
- 4 is more reactive than hydrofluoric acid.

Turn over for the next question

Turn over ►

QUESTION SIX

The map gives information about tectonic plates and volcanoes in the western hemisphere.



6A What pattern does this information suggest?

- 1 Explosive volcanoes erupt more frequently than non-explosive volcanoes.
- 2 Explosive volcanoes usually occur where tectonic plates are moving together.
- 3 Non-explosive volcanoes occur only along the coasts of continents.
- 4 Non-explosive and explosive volcanoes are active at the same time.

6B Where would you expect earthquakes to occur?

- 1 in the areas where there are explosive volcanoes only
- 2 where tectonic plates are moving away from each other only
- 3 at the boundaries between two tectonic plates
- 4 in ocean areas only

6C Only a few minor earthquakes happen in Britain.

This is because . . .

- 1 Britain lies on a plate that is not moving.
- 2 there are no volcanoes in Britain.
- 3 the oceans around Britain are very shallow.
- 4 Britain is not close to a plate boundary.

6D Earthquakes happen in Iceland.

Scientists know that, in the future, earthquakes . . .

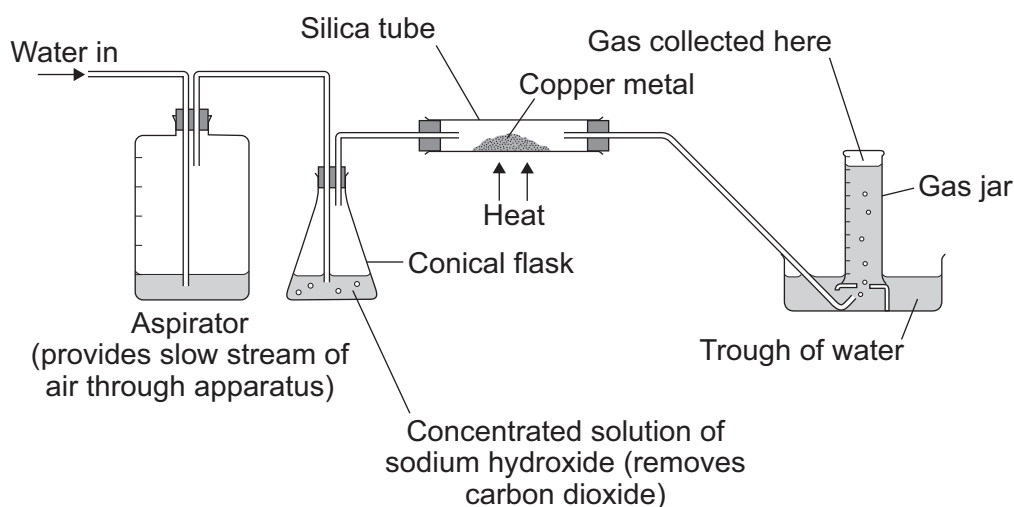
- 1 will happen in Iceland but cannot predict when because they occur at random intervals.
- 2 will not happen in Iceland for many years and cannot predict when because they occur at random intervals.
- 3 will happen in Iceland but cannot predict when because they occur in five-year or ten-year cycles.
- 4 will not happen in Iceland for another ten years because it takes so long for pressure to build up.

Turn over for the next question

Turn over ►

QUESTION SEVEN

A student used the apparatus in the diagram below to investigate the composition of air.



7A The student was advised not to collect the gas in the gas jar for 2 minutes.

This is because . . .

- 1 the gas had not reached room temperature.
- 2 not all the carbon dioxide from the aspirator would have been removed.
- 3 the gas collected would contain unchanged air.
- 4 other gases would be produced as the copper decomposed.

7B After 2 minutes, 1000 cm³ of air was passed through the apparatus.

Which row in the table correctly shows the volume of gas collected in the gas jar **and** the name of the compound formed in the silica tube?

	Volume of gas collected in the gas jar in cm ³	Name of the compound formed in the silica tube
1	80	copper oxide
2	200	copper carbonate
3	800	copper oxide
4	800	copper carbonate

7C The total volume of gas collected in the gas jar was less than the student expected.

A possible reason is that . . .

- 1 the gas jar was not completely full of water at the start of the investigation.
- 2 not all the carbon dioxide had been removed from the air.
- 3 some copper metal in the silica tube had not reacted.
- 4 one of the rubber stoppers was not fitted correctly.

7D Which gases will be collected in the gas jar?

- 1 carbon monoxide and nitrogen only
- 2 carbon monoxide, nitrogen and noble gases
- 3 nitrogen and noble gases
- 4 nitrogen only

Turn over for the next question

Turn over ►

QUESTION EIGHT

The table shows two different processes that are used to make ethanol.

	Process 1	Process 2
Reaction	Fermentation of a sugar solution using yeast	Reaction of ethene with steam
Method	Batch – the reaction vessel is emptied and refilled every few days	Continuous – ethanol flows from the reaction vessel for many years
Product	Dilute solution of ethanol	Pure ethanol
Rate of Production	Slow	Fast

8A The most important advantage of producing the ethanol by **Process 1** is that . . .

- 1 there is no waste to dispose of.
- 2 the dilute solution of ethanol is not hazardous to handle.
- 3 the raw materials are renewable.
- 4 the reaction vessel can be kept clean.

8B The ethene for **Process 2** is obtained . . .

- 1 by fractional distillation of crude oil.
- 2 by cracking alkanes that have large molecules.
- 3 by cracking alkenes that have large molecules.
- 4 by polymerisation of small alkene molecules.

8C One advantage of producing ethanol using **Process 2** is that . . .

- 1 lower temperatures are needed for the reaction.
- 2 crude oil can be transported in larger quantities than sugar.
- 3 large quantities can be produced in a short time.
- 4 no expensive catalysts are needed.

8D In some countries, many cars are powered by ethanol. These countries produce large amounts of ethanol using **Process 1**.

Production of ethanol using **Process 1** is probably of economic benefit only if a country . . .

- 1 has large reserves of crude oil.
- 2 has a large workforce to regularly fill and empty the reaction vessels.
- 3 has agricultural land and a climate suitable for growing sugar cane.
- 4 has sufficient wealth to import crude oil.

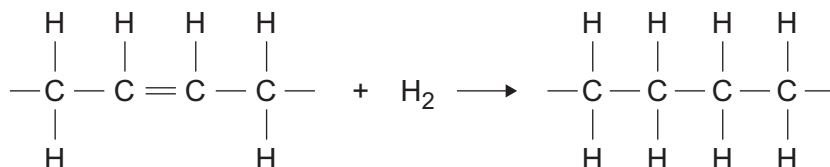
Turn over for the next question

Turn over ►

QUESTION NINE

Most vegetable oils contain unsaturated molecules.

They can be converted into saturated compounds, as shown in **Equation 1**.

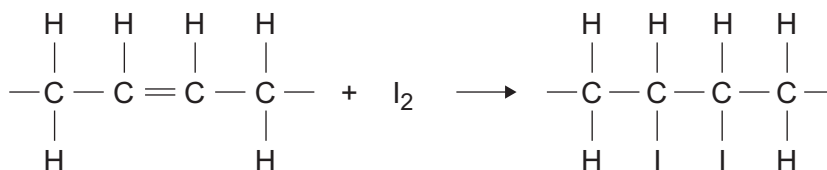
Equation 1

Part of an unsaturated
molecule in sunflower oil

- 9A** Which one of the following shows the correct conditions for this reaction?
- 1 react with hydrogen using a nickel catalyst at 60 °C
 - 2 vaporise and pass the vapours over a hot iron catalyst
 - 3 react with oxygen using a nickel catalyst below 37 °C
 - 4 vaporise and pass the vapours over a nickel catalyst below 37 °C
- 9B** Compared with the unsaturated compound in sunflower oil, the saturated compound produced in **Equation 1** . . .
- 1 has a softer consistency.
 - 2 has a higher melting point.
 - 3 has more carbon atoms in each molecule.
 - 4 has fewer hydrogen atoms in each molecule.

Iodine reacts with the double carbon carbon bond in unsaturated hydrocarbons, as shown in **Equation 2**.

Equation 2



The iodine number is the number of grams of iodine that will react with 100 grams of the unsaturated hydrocarbon.

9C Which of the following is a true statement?

- 1 the higher the iodine number, the smaller the oil molecules
- 2 the higher the iodine number, the larger the oil molecules
- 3 the higher the iodine number, the fewer double bonds in each oil molecule
- 4 the higher the iodine number, the more double bonds in each oil molecule

9D 2.5 grams of iodine was added to 1.0 grams of a vegetable oil. When the reaction finished, 1.0 grams of iodine was left unreacted.

What is the iodine number of this vegetable oil?

- 1 100
- 2 150
- 3 200
- 4 250

END OF TEST

There are no questions printed on this page