

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Foundation Tier and Higher Tier
March 2010

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

CHY1BP
F&H

Wednesday 3 March 2010 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

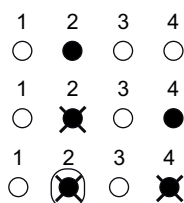
- 30 minutes

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 gases.

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

- A** oxygen
- B** nitrogen
- C** carbon dioxide
- D** helium

1	It makes up about 20% of the Earth's atmosphere today.
2	It is locked up as carbonates in sedimentary rocks.
3	It is found in Group 0 of the periodic table.
4	It makes up about 80% of the Earth's atmosphere today.

QUESTION TWO

Many food additives are given E-numbers.

- Colourings have E-numbers from 100 to 199.
- Preservatives have E-numbers from 200 to 299.
- Substances to stop food from reacting with oxygen have E-numbers from 300 to 399.
- Emulsifying agents have E-numbers from 400 to 499.

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

A E150

B E210

C E300

D E450

1	used to make gravy mixture brown in colour
2	used to stop salad dressing from separating
3	used to stop fruit from going brown in the air
4	used to increase the shelf-life of jam

Turn over for the next question

Turn over ►

QUESTION THREE

Some vehicles can use biodiesel fuel. Many plants are a source of biodiesel.

Linseed is a plant that can produce about 400 litres of biodiesel per hectare.

Producing all the biodiesel needed by the USA from linseed would need 25 % of their arable land. Arable land is land that can be used to grow plants for food.

The table gives some data on four other plants.

	Plant	Amount of biodiesel produced in litres per hectare	Type of land where plant will grow
A	Maize	100	Arable
B	Sunflower	800	Arable
C	Coconut	3 000	Arable
D	Algae	14 000	Desert

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

1	This plant uses no arable land.
2	This plant would need half as much arable land as linseed to produce all the biodiesel needed in the USA.
3	This plant would need all of the arable land in the USA to produce all the biodiesel needed in the USA.
4	This plant would need arable land but it would use the smallest amount.

QUESTION FOUR

The table below shows the masses of some gases given off when one gram of each of the polymers, **A**, **B**, **C** and **D**, are burnt in air.

		Combustion products in mg						
	Polymer name	C ₂ H ₄	CH ₄	CO ₂	CO*	NO ₂ *	HCN*	NH ₃ *
A	Kevlar	–	–	1850	50	10	14	0.5
B	Acrylic	5	17	1300	170	45	40	3.0
C	66 Nylon	50	25	1200	250	20	30	–
D	Polyester	6	10	1000	350	–	–	–

Toxic gases are marked with *.

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

- 1 the polymer that produces the most HCN
- 2 the polymer that produces the most ethene
- 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

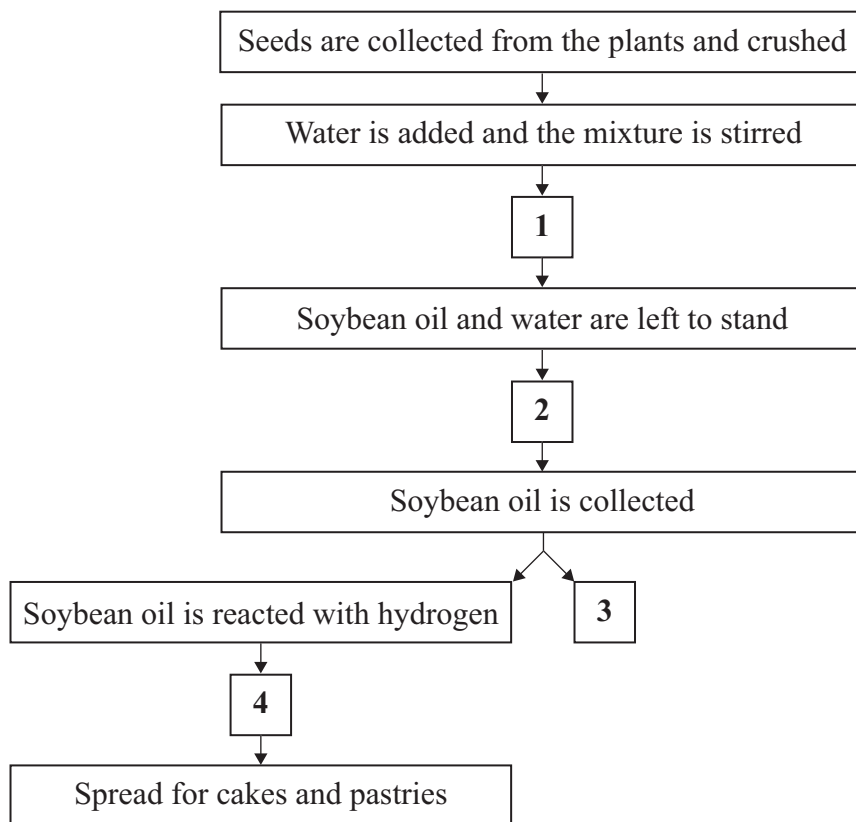
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QUESTION FIVE

This question is about the extraction and uses of soybean oil.

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

- A** The modified oil solidifies and additives are mixed in
- B** Soybean oil is used as biofuel in vehicles
- C** Soybean oil separates from the water
- D** Mixture of soybean seeds and water is pressed



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.

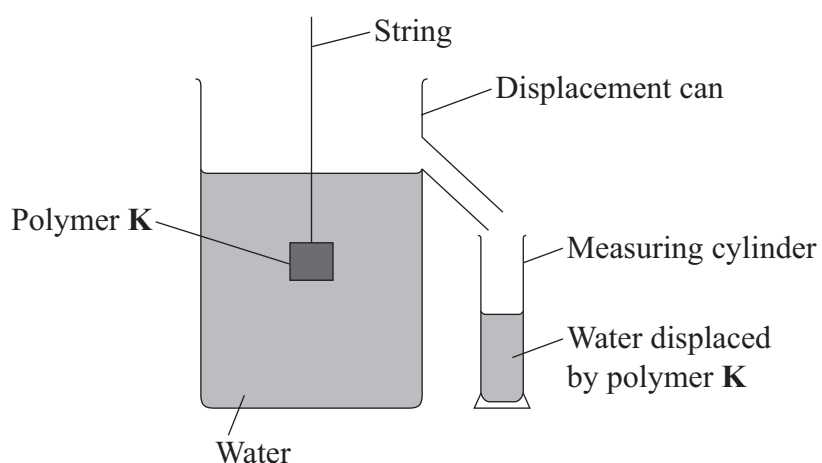
Mark your choices on the answer sheet.

QUESTION SIX

Some polymers can be used for tooth fillings. A good polymer should not shrink in the tooth cavity.

A scientist tested a polymer, **K**, to see how much it shrinks when it sets.

- He made a sample of the polymer in a container with a volume of 10 cm^3 exactly.
- He allowed the polymer to set hard.
- He removed the polymer from the container and measured its volume again, using the apparatus shown.
- He repeated the test three times.



The scientist then tested three different polymers, **L**, **M** and **N**, in exactly the same way.

The results are shown in the table.

Polymer	Volume of water displaced in cm^3			
	Test 1	Test 2	Test 3	Test 4
K	9.6	9.8	9.7	9.8
L	7.8	8.2	8.9	10.2
M	9.2	9.5	9.6	10.0
N	9.2	9.6	8.5	9.7

-
- 6A** Which statement about the results is correct?
- 1 All four polymers would be equally good as dental fillings.
 - 2 Polymer **K** shows the most consistent results.
 - 3 Polymer **L** is the best for dental fillings because it gives the highest values.
 - 4 If the third test is ignored, polymer **N** is the best polymer for dental fillings.
- 6B** Which one of the following could be the reason for the reading of 10.2 cm^3 for polymer **L**, **Test 4**?
- 1 The piece of string was too long.
 - 2 The polymer was dropped into the water in the displacement can.
 - 3 At the start, the water was below the level of the spout.
 - 4 Some water had evaporated.
- 6C** One of the tests on polymer **M** gives a volume of 10.0 cm^3 .
- Does this mean it is the best polymer?
- 1 Yes, because it has given the volume needed.
 - 2 No, because a single result should not be relied upon.
 - 3 Yes, because it would be the highest value that could be obtained.
 - 4 No, because the first test is always the most accurate.
- 6D** Any polymer used for dental fillings should **not** be biodegradable because it would . . .
- 1 cost too much to make.
 - 2 be poisonous.
 - 3 shrink too much.
 - 4 break down after it has been put in place.

QUESTION SEVEN

Until about 150 years ago, many scientists thought that the mountain ranges and valleys on the Earth had hardly changed since the Earth was formed.

One theory about how new mountain ranges may have formed involves the following events. They are **not** in the correct order.

- W** – As the core shrinks, it makes the crust wrinkle; the tops of the wrinkles become the mountains.
- X** – The outer layer of molten rock cooled to form the solid Earth's crust.
- Y** – The Earth began as a huge ball of molten rock.
- Z** – The molten core continues to cool and it shrinks as it cools.

7A The best sequence for these events is . . .

- 1** Y, Z, W, X.
- 2** Y, X, Z, W.
- 3** Y, W, X, Z.
- 4** Y, X, W, Z.

7B One reason that this theory is **not** now accepted is because we know that . . .

- 1** the Earth's crust is divided into plates.
- 2** earthquakes produce mountain ranges.
- 3** all mountain ranges are formed by active volcanoes.
- 4** wrinkles in the Earth's crust can only form low hills.

7C Scientists now think that mountain ranges are formed . . .

- 1** by the Earth's crust expanding as it heats up.
- 2** by earthquakes in the mantle.
- 3** by large-scale movements of the Earth's crust.
- 4** by weathering and erosion of old mountain ranges.

7D It is now accepted that the interior of the Earth remains hot because of . . .

- 1 friction between the moving tectonic plates.
- 2 volcanic activity at the plate boundaries.
- 3 friction between the core and the mantle.
- 4 natural radioactive processes.

Turn over for the next question

Turn over ►

QUESTION EIGHT

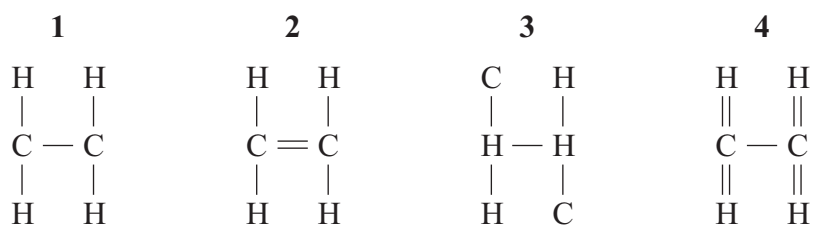
The two equations below show reactions involving hydrocarbons.



8A The reactions are examples of . . .

- 1 condensation.
- 2 polymerisation.
- 3 cracking.
- 4 hydrogenation.

8B The hydrocarbon C_2H_4 can be represented by . . .



8C In the equations, the two hydrocarbons that are alkenes are . . .

- 1 C_2H_4 and C_4H_8
- 2 C_2H_4 and C_4H_{10}
- 3 C_2H_4 and C_5H_{12}
- 4 $\text{C}_{11}\text{H}_{24}$ and C_4H_{10}

8D Which of the hydrocarbons is used to make poly(ethene)?

- 1 C_2H_4
- 2 C_4H_8
- 3 C_4H_{10}
- 4 C_5H_{12}

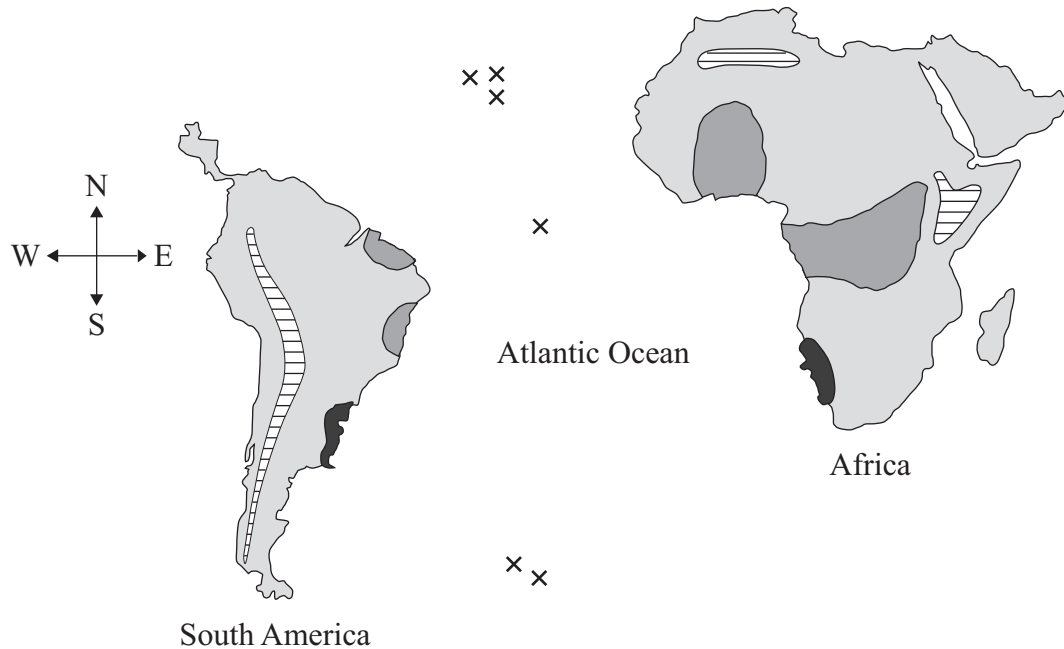
Turn over for the next question





Turn over ►

QUESTION NINE

The diagram shows the positions of the continents of South America and Africa today.

Some of the rock formations are also shown.



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

9A The shape of the east coast of South America suggests that it would fit into the west coast of Africa.

This could indicate that . . .

- 1 Africa is slowly sliding past South America.
- 2 sea levels in the Atlantic Ocean are gradually rising.
- 3 the two land masses are slowly moving together.
- 4 Africa and South America were once joined.

-
- 9B** Early in the twentieth century, an accepted theory was that millions of years ago there had been a land bridge connecting South America and Africa.

What evidence is there on the diagram that could have given rise to this theory?

- 1 There are mountain ranges on both continents.
- 2 There are ancient rocks on both continents.
- 3 South America and Africa are quite close together.
- 4 There are similar fossils in the rocks on the two continents.

- 9C** South America and Africa are on different tectonic plates.

From the evidence on the diagram, where is the boundary between these tectonic plates?

- 1 along the east coast of South America
- 2 from north to south through the middle of the Atlantic Ocean
- 3 from east to west across the Atlantic Ocean
- 4 along the west coast of Africa

- 9D** The Atlantic Ocean is about 5000 km wide. It is estimated that it has been widening by about 2 cm every year since it first formed.

The time taken for the Atlantic Ocean to reach its present width is about . . .

- 1 1000 years.
- 2 25 000 years.
- 3 250 million years.
- 4 1000 million years.

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**.

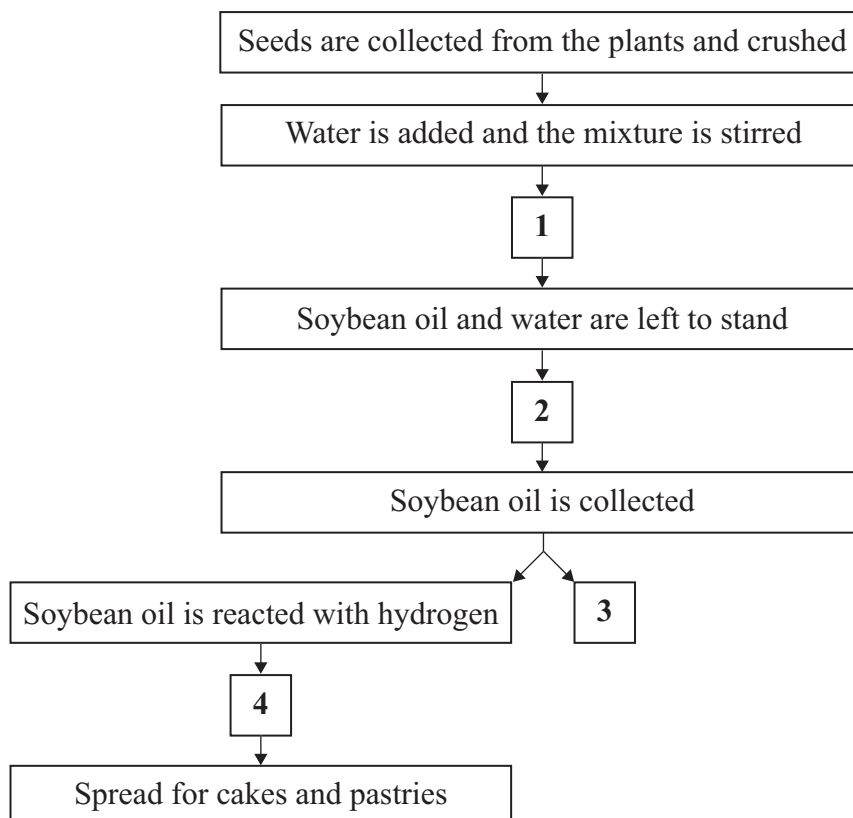
Mark your choices on the answer sheet.

QUESTION ONE

This question is about the extraction and uses of soybean oil.

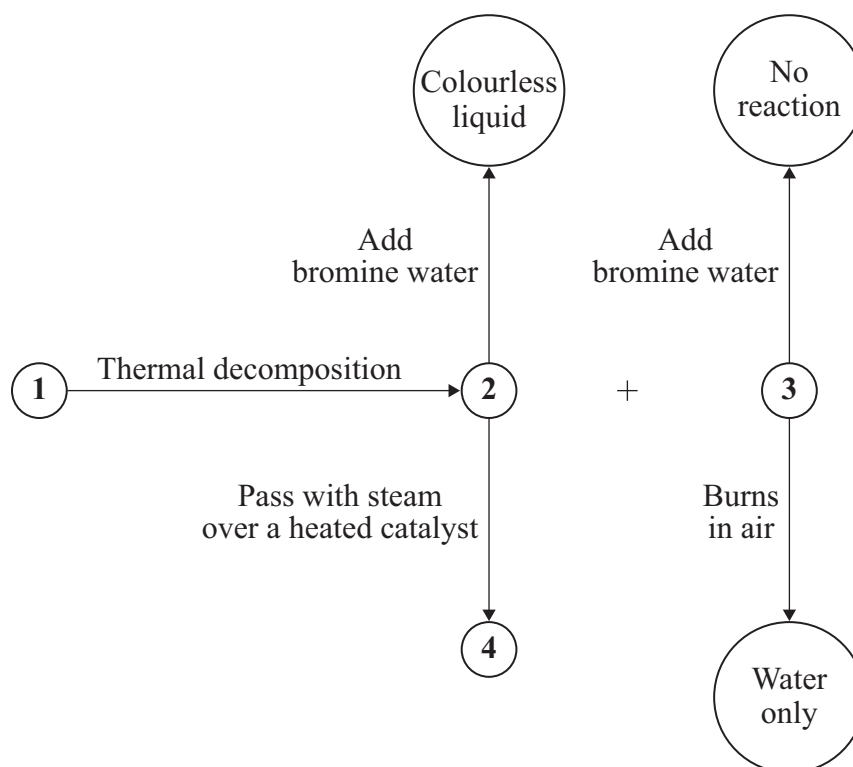
Match statements, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart.

- A** The modified oil solidifies and additives are mixed in
- B** Soybean oil is used as biofuel in vehicles
- C** Soybean oil separates from the water
- D** Mixture of soybean seeds and water is pressed



QUESTION TWO

The flow chart shows a series of chemical reactions.



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

- A** Ethane
- B** Ethene
- C** Ethanol
- D** Hydrogen

Turn over ►

SECTION TWO

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

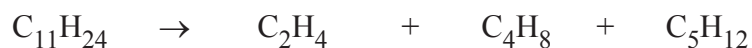
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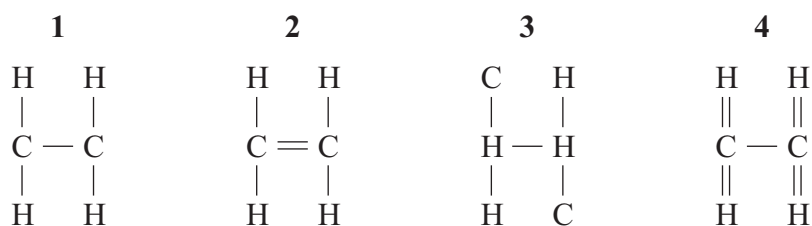
 Mark your choices on the answer sheet.

QUESTION THREE

The two equations below show reactions involving hydrocarbons.


3A The reactions are examples of . . .

- 1 condensation.
- 2 polymerisation.
- 3 cracking.
- 4 hydrogenation.

3B The hydrocarbon C_2H_4 can be represented by . . .

3C In the equations, the two hydrocarbons that are alkenes are . . .

- 1 C_2H_4 and C_4H_8
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3D Which of the hydrocarbons is used to make poly(ethene)?

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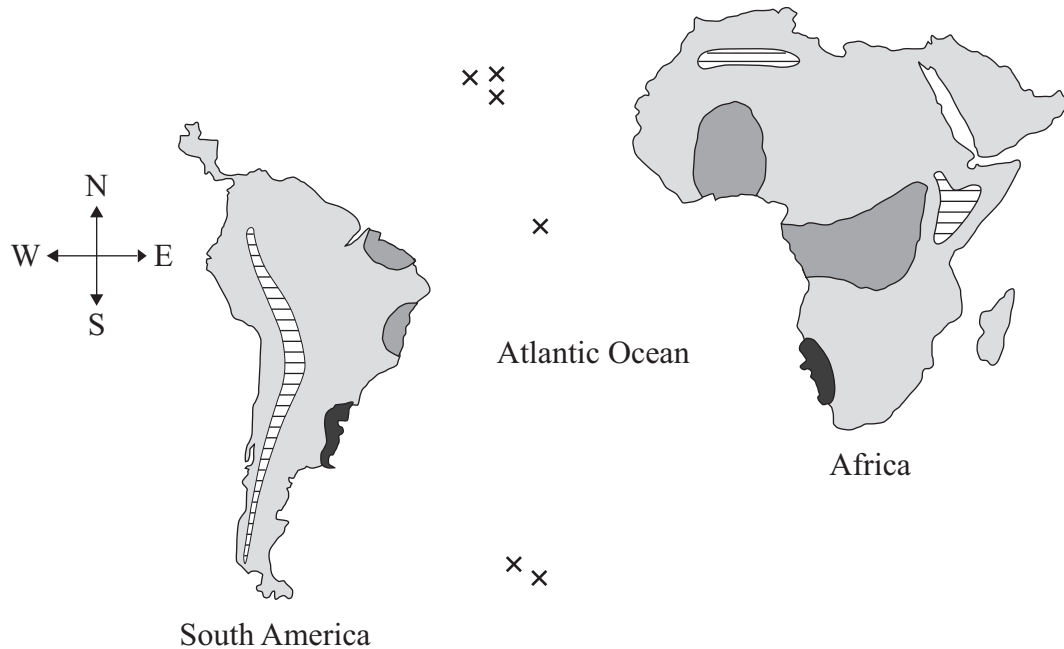
Turn over for the next question

Turn over ►

QUESTION FOUR

The diagram shows the positions of the continents of South America and Africa today.

Some of the rock formations are also shown.



Key	
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	Sandstone containing similar fossils
	Mountains
	Volcano

4A The shape of the east coast of South America suggests that it would fit into the west coast of Africa.

This could indicate that . . .

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- 4 1000 million years.

QUESTION FIVE

Some properties of two forms of poly(ethene) are shown in the table.

Polymer	Density in kg per m ³	Tensile strength in MPa
Low-density poly(ethene) – LDPE	925	16
High-density poly(ethene) – HDPE	950	28

The molecules of low-density poly(ethene) and high-density poly(ethene) are represented in the diagrams.

Low-density poly(ethene) – LDPE



High-density poly(ethene) – HDPE

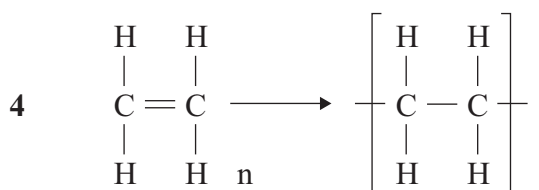
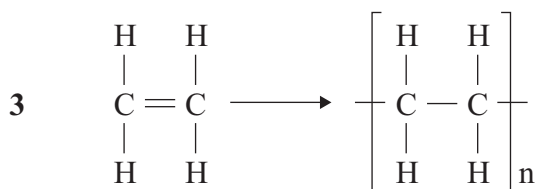
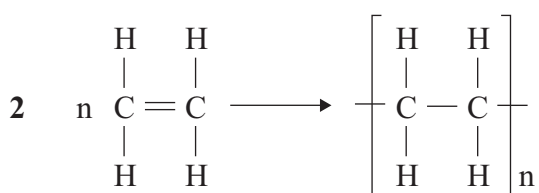
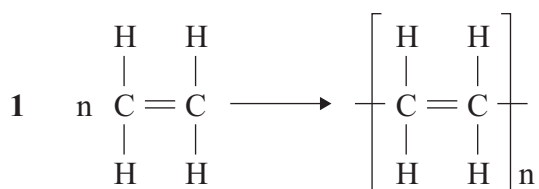


- 5A** The reason for the differences in strength and density between LDPE and HDPE is that . . .
- 1 they contain different elements in their structure.
 - 2 they were made under different conditions.
 - 3 they have different colours added.
 - 4 different monomers are used to make the chains.
- 5B** HDPE has a higher density than LDPE because . . .
- 1 it is stronger.
 - 2 more plastic is used to make LDPE.
 - 3 the polymer molecules pack closer together in HDPE.
 - 4 LDPE has shorter polymer chains.

5C Which is the most appropriate method for disposal of a non-biodegradable polymer such as poly(ethene)?

- 1 freeze it so that it returns to the original monomer
- 2 dispose of it at sea
- 3 bury it in the ground
- 4 break it down by adding microorganisms

5D Which one of the following is the correct balanced equation for the polymerisation of ethene to form poly(ethene)?



QUESTION SIX

Recycling of plastic bottles increased between 1994 and 2005.

Year	Tonnes of plastic bottles recycled
1994	2 000
1995	4 000
1996	5 000
1997	6 000
1998	9 000
1999	10 000
2000	11 000
2001	13 000
2002	18 000
2003	25 000
2004	38 000
2005	63 000

6A If the rate of recycling plastic bottles continued to follow this trend, the quantity recycled in 2006 would have been . . .

- 1** 70 000 tonnes.
- 2** 99 000 tonnes.
- 3** 200 000 tonnes.
- 4** 350 000 tonnes.

6B Between which two years was there the greatest percentage growth in recycling plastic bottles?

- 1 1994 to 1995
- 2 1999 to 2000
- 3 2002 to 2003
- 4 2004 to 2005

6C The data in the table on page 24, could be presented as a bar chart.

Which row of the table below gives the correct data types for tonnes of plastic bottles and the year?

	Tonnes of plastic bottles	Year
1	Continuous	Categoric
2	Discrete	Continuous
3	Categoric	Continuous
4	Continuous	Discrete

6D The government should encourage the recycling of plastic bottles because . . .

- 1 there is an unlimited supply of the raw material.
- 2 landfill sites cannot take plastic bottles.
- 3 plastic bottles are made from a non-renewable raw material.
- 4 plastic bottles may decompose after use.

Turn over ►

QUESTION SEVEN

This question is about the Earth.

7A The density of the Earth's crust is about 2800 kg per m^3 , but the overall density of the Earth is about 5500 kg per m^3 .

A valid conclusion from this information is that . . .

- 1 the mantle is denser than the crust.
- 2 the core is denser than the crust.
- 3 the average density of the core and mantle is greater than the density of the crust.
- 4 the average density of the core and mantle is less than the density of the crust.

7B The rocks of the mantle are semi-molten because of . . .

- 1 the heat retained from when the Earth was first formed from the Sun.
- 2 the frictional forces between the core and the mantle.
- 3 the decay of radioactive substances in the mantle.
- 4 the atmosphere absorbing radiation from the Sun.

7C Earthquakes occur at plate boundaries because . . .

- 1 the plates expand against each other due to the heat of the magma.
- 2 the plates move past each other due to convection currents in the mantle.
- 3 the plates slowly contract away from each other as the Earth cools.
- 4 the plates push past each other due to the expansion of the core.

7D Scientists can predict the regions where earthquakes will occur, but not when they will occur.

This is because . . .

- 1 earthquakes occur at random intervals.
- 2 earthquakes usually occur deep in the oceans.
- 3 earthquakes occur in ten-year or twenty-year cycles.
- 4 earthquakes occur infrequently and vary in strength.

Turn over for the next question

Turn over ►

QUESTION EIGHT

All the gases in the Earth's atmosphere can be separated by this method:

- remove the carbon dioxide
- cool the air down to a very low temperature so that it liquefies
- allow the liquefied gases to warm up
- collect the gases as they boil off at different temperatures.

The table below gives some information about the gases in the Earth's atmosphere.

Gas	Melting point in °C	Boiling point in °C	Abundance in %
Oxygen	-223	-183	21
Nitrogen	-209	-196	78
Carbon dioxide	-57	-57	0.03
Helium	-272	-269	Less than 0.1
Neon	-248	-246	Less than 0.1
Argon	-189	-186	0.9
Krypton	-157	-153	Less than 0.1
Xenon	-112	-108	Less than 0.1

8A In this method of separation, carbon dioxide is always removed from the air before it is liquefied because . . .

- 1 it would react with the other gases present.
- 2 it would solidify during cooling and block up the pipes.
- 3 it is a greenhouse gas and would warm up the apparatus.
- 4 it is a heavy gas and would not separate properly from the mixture.

8B How many of the gases listed in the table (excluding carbon dioxide), would be liquid at -150°C ?

1 None

2 1

3 2

4 3

8C Argon is the cheapest of the noble gases to produce because . . .

1 there is high demand for it for use in light bulbs.

2 it is the most abundant of the noble gases.

3 it is the gas that vaporises most easily and so requires the least energy to remove it.

4 it is an unreactive gas so it can easily be separated from the other gases in the air.

8D Earth's early atmosphere contained a high percentage (%) of carbon dioxide.

One reason for the reduction of the percentage of carbon dioxide is that carbon dioxide . . .

1 has dissolved in the oceans.

2 has been reduced to carbon monoxide.

3 has decomposed to form carbon and oxygen.

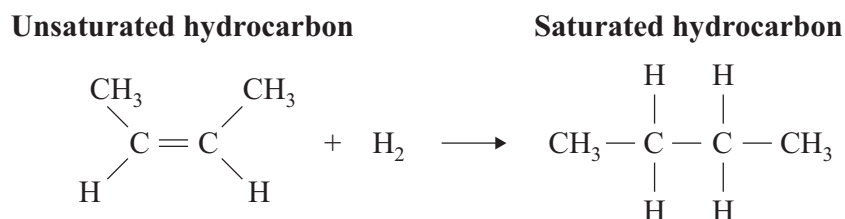
4 has been released by plants.

Turn over for the next question

Turn over ►

QUESTION NINE

Unsaturated oils contain double carbon carbon bonds. If an unsaturated hydrocarbon is heated with hydrogen gas and a nickel catalyst, the following reaction takes place.



9A What is this process called?

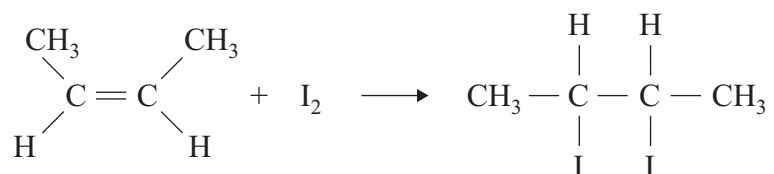
- 1 cracking
- 2 polymerisation
- 3 hydrogenation
- 4 combustion

9B An unsaturated oil is made into a saturated compound.

The saturated compound . . .

- 1 contains fewer hydrogen atoms in its molecules.
- 2 has a higher melting point.
- 3 feels softer but has the same melting point.
- 4 would be more useful as a fuel for vehicles.

9C Iodine (I₂) reacts with unsaturated hydrocarbons as shown in the equation.



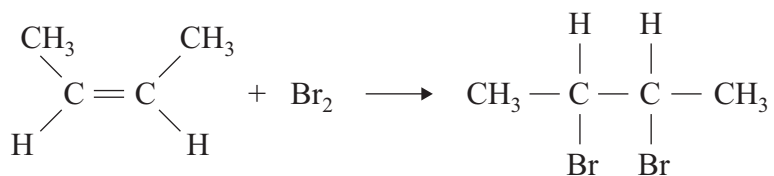
The iodine number is the number of grams of iodine that will react with 100 g of the unsaturated hydrocarbon. The higher the iodine number, the more unsaturated the hydrocarbon is.

3 g of iodine are added to 1 g of a vegetable oil. When the reaction has finished, 1.2 g of iodine are left unreacted.

What is the iodine number of the oil?

- 1 120
- 2 180
- 3 240
- 4 300

9D Bromine (Br₂) reacts with unsaturated hydrocarbons in the same way as iodine.



If bromine water is added drop-by-drop to a sample of vegetable oil, the bromine will be decolourised until all the double carbon carbon bonds have reacted.

A sample of an oil with an iodine number of 150 decolourises 25 drops of bromine water. The same amount of another vegetable oil decolourises 6 drops of the same bromine water.

What is the iodine number of the second oil?

- 1 30
- 2 36
- 3 40
- 4 45

END OF TEST

There are no questions printed on this page