

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A171/02

TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A

Modules C1 C2 C3 (Higher Tier)

MONDAY 20 MAY 2013: Afternoon

DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:


Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

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

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil ().
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is 60.
- Any blank pages are indicated.

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Answer ALL the questions.

- 1 Sulfur dioxide is released from a coal-burning power station.**

Scientists study this air pollution.

They move from the power station along a line in the direction the wind is blowing. They collect air samples at different distances along the line.

They collect six air samples at each distance and measure the sulfur dioxide concentration in each sample.

Then they work out the best estimate of the sulfur dioxide concentration at each distance.

- (a) The results measured at 4 km are shown opposite.**

The measurement of sample 5 gave a much lower value than the other samples.

The scientists still used the measurement from sample 5 when working out the best estimate at 4 km.

Suggest reasons why they did not discard this sample.

[2]

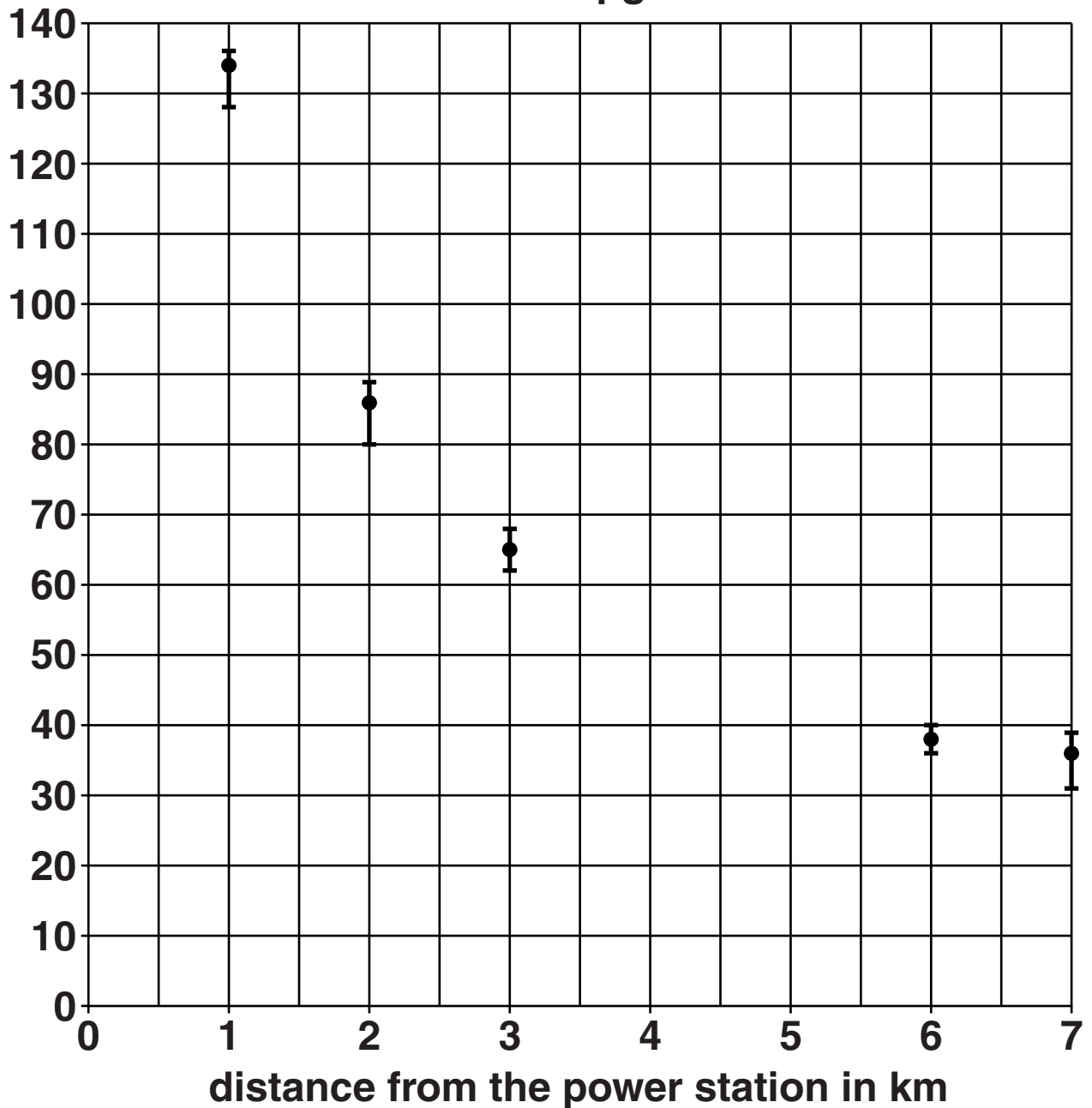
	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6
SULFUR DIOXIDE CONCENTRATION IN $\mu\text{g}/\text{m}^3$	52	53	54	52	46	55

(b) The table opposite shows the best estimate and range of sulfur dioxide concentrations at each distance.

(i) Five of these results have been plotted on the grid. Plot the other results, including range bars. [2]

(ii) Draw a curve of best fit. [1]

sulfur dioxide concentration in $\mu\text{g}/\text{m}^3$



DISTANCE FROM THE POWER STATION IN km	1	2	3	4	5	6	7
CONCENTRATION IN $\mu\text{g}/\text{m}^3$	134	86	65	52	43	38	36
RANGE IN $\mu\text{g}/\text{m}^3$	128–136	80–89	62–68	46–55	40–45	36–40	31–39

(iii) Describe in detail the trend shown in the graph.

[2]

(iv) Use the table to evaluate the confidence you can have in the results.

[2]

(c) Sulfur dioxide does not build up in the atmosphere.

How is it removed?

Put ticks (✓) in the boxes next to the THREE statements that, when taken together, give the best explanation.

☐

Sulfur is made.

☐

Sulfur dioxide reacts with water vapour.

☐

Sulfur dioxide reacts with carbon dioxide.

☐

Sulfur dioxide reacts with oxygen.

☐

Acid rain is made.

☐

Sulfur dioxide reacts with nitrogen.

[2]

[TOTAL: 11]

2 (a) Methane, CH₄, is a chemical in natural gas.

When methane burns in a plentiful supply of air,
COMPLETE COMBUSTION takes place.

The products are carbon dioxide and water.

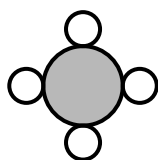
(i) Finish this diagram to show the complete combustion of one molecule of methane.

methane

oxygen

carbon dioxide

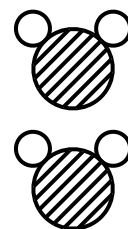
water



+



+



[2]

- (ii) When hydrocarbons burn in a limited supply of oxygen, **INCOMPLETE COMBUSTION** takes place.

Describe what happens during the incomplete combustion of hydrocarbons and explain why this can be harmful to health.



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

[6]

- (b) During the last 100 years, the burning of fossil fuels has released a large quantity of carbon dioxide into the atmosphere.**

Despite this, the percentage of carbon dioxide in the atmosphere has risen only from approximately 0.03% to approximately 0.04%.

Explain why the percentage of carbon dioxide has not risen higher.

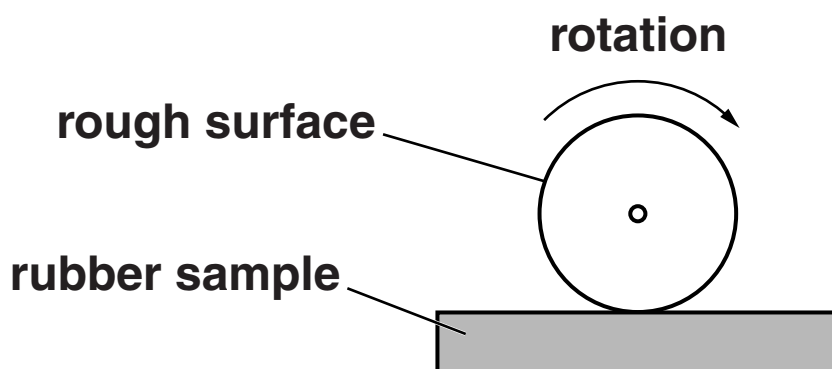
[2]

[TOTAL: 10]

- 3 Vulcanised rubber is made by reacting natural rubber with sulfur. During the reaction, the sulfur forms cross-links between the polymer chains.**

Samples of vulcanised rubber and natural rubber are tested to see how hard-wearing they are.

Scientists measure the time taken to wear away 1.0 cm of the rubber.



(a) When the rubber samples are tested, a number of factors are kept constant.

(i) Suggest two of these factors.

1 _____

2 _____

[2]

(ii) Why should these factors be kept constant?

Put a tick (✓) in the box next to the best answer.

☐

To make it easier to set up the apparatus.

☐

So that a comparison can be made between the properties of the two types of rubber.

☐

So that the same apparatus could be used for both sets of measurements.

☐

The only thing that affects the results must be the factor that is being investigated.

[1]

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(b) Results of the tests are shown in the table opposite.

(i) Sam says that the results show there is a definite difference between the properties of the two types of rubber.

Use ideas about range and mean to show that Sam is correct.

[2]

SAMPLE NUMBER		1	2	3	4	5	6	RANGE	MEAN
TIME IN MINS TO WEAR AWAY 1.0cm RUBBER	NATURAL RUBBER	13	15	12	13	11	14	11-15	13
	VULCANISED RUBBER	34	33	35	37	33	32	32-37	34

- (ii) Vulcanisation has changed the properties of the rubber.**

Which two statements, when taken together, describe WHY the properties have changed?

Put ticks (✓) in the boxes next to the TWO correct statements.

- ☐ **The molecules in natural rubber are held together by weak forces.**
- ☐ **Natural rubber has higher density than vulcanised rubber.**
- ☐ **Vulcanised rubber has longer chains of atoms than natural rubber.**
- ☐ **Sulfur links the rubber chains together by covalent bonds.**
- ☐ **Sulfur increases the strength of the covalent bonds in the rubber molecules.**

[2]

- (iii) Cross-linking is one way in which the properties of a polymer can be changed.**

Suggest TWO OTHER modifications that can be used to change the properties of a polymer.

1 _____

2 _____

[2]

[TOTAL: 9]

4 Crude oil is a mixture of hydrocarbons.

Information about some of these hydrocarbons is given in the table.

HYDROCARBON	FORMULA	MELTING POINT IN °C	BOILING POINT IN °C
methane	CH ₄	−182	−164
ethane	C ₂ H ₆	−183	−89
propane	C ₃ H ₈	−188	−42
butane	C ₄ H ₁₀	−138	−0.5
pentane	C ₅ H ₁₂	−130	36

(a) Which of these hydrocarbons is a liquid at 25 °C?

_____ [1]

(b) (i) Describe the trend in the boiling points of these hydrocarbons.

_____ [1]

- (ii) Butane gas is used as a fuel. It is sold in cylinders for use when camping.

It is difficult to use a butane stove at temperatures below 0°C .

Explain why.

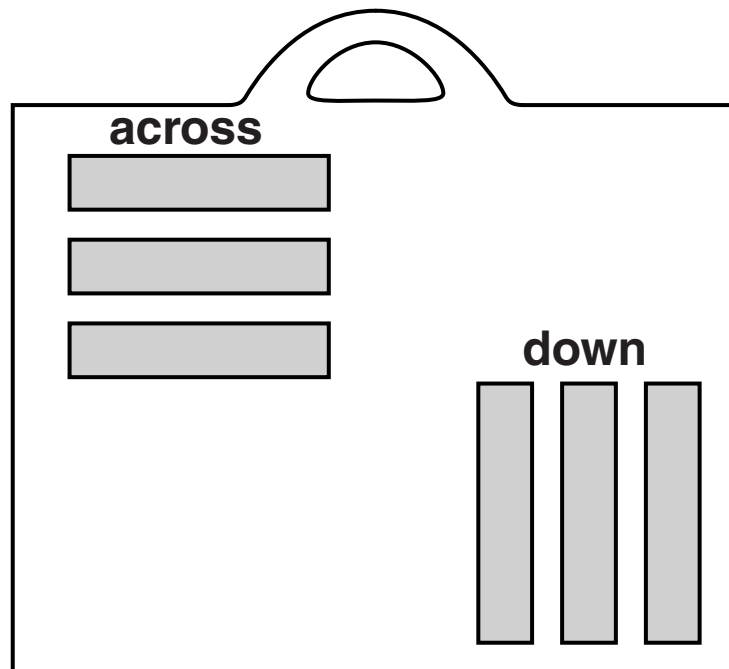
[2]

[TOTAL: 4]

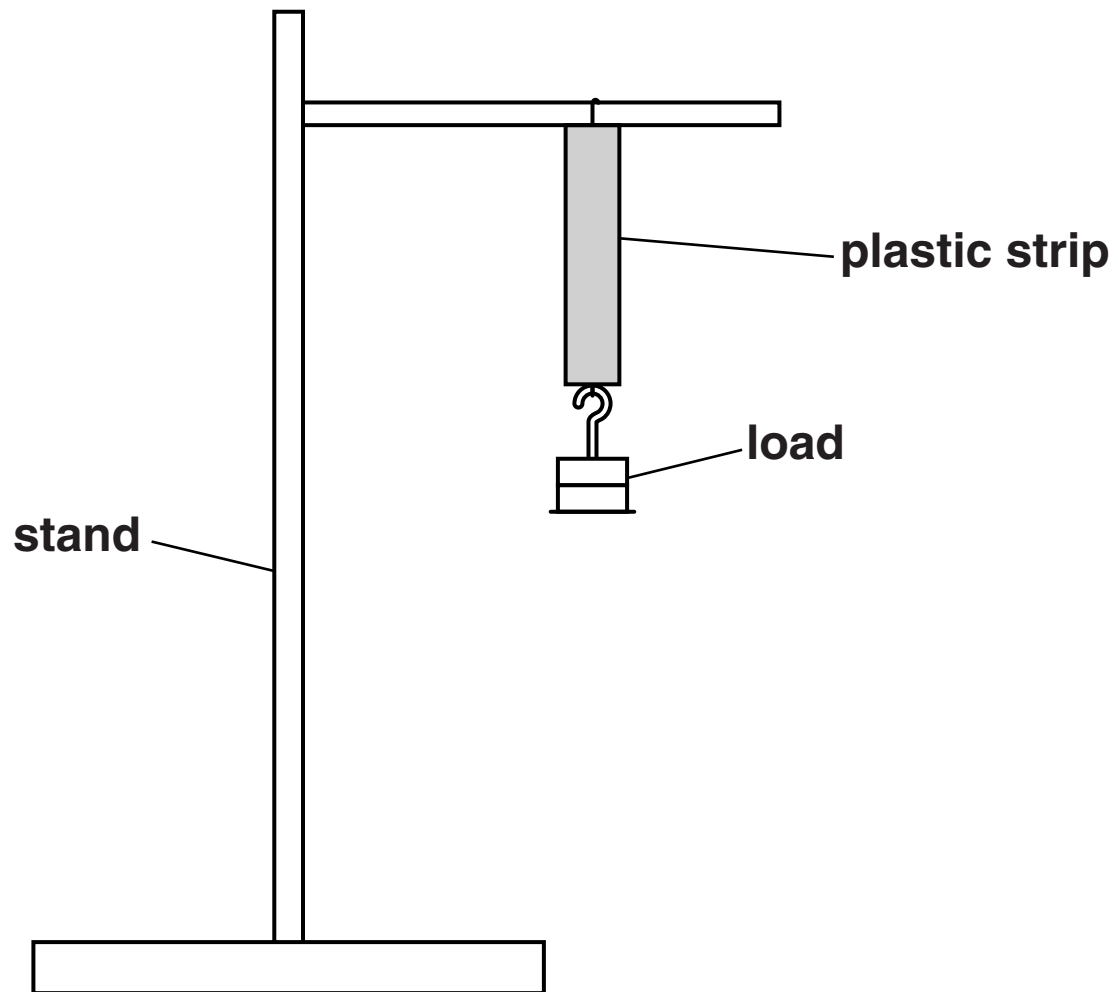
5 Students test strips of plastic from a shopping bag.

They cut some strips DOWN the bag.

They cut some strips ACROSS the bag.



They use this apparatus.



Their results are shown below.

STRIPS ACROSS THE BAG		
LOAD IN g	LENGTH IN mm	TOTAL STRETCH IN mm
0	200	0
100	222	22
200	243	43
300	265	65
400	286	86
500	307	107

STRIPS DOWN THE BAG		
LOAD IN g	LENGTH IN mm	TOTAL STRETCH IN mm
0	200	0
100	209	9
200	221	21
300	231	31
400	242	42
500	252	52

(a) Compare the two tables of results.

Which of these statements can you conclude from these data?

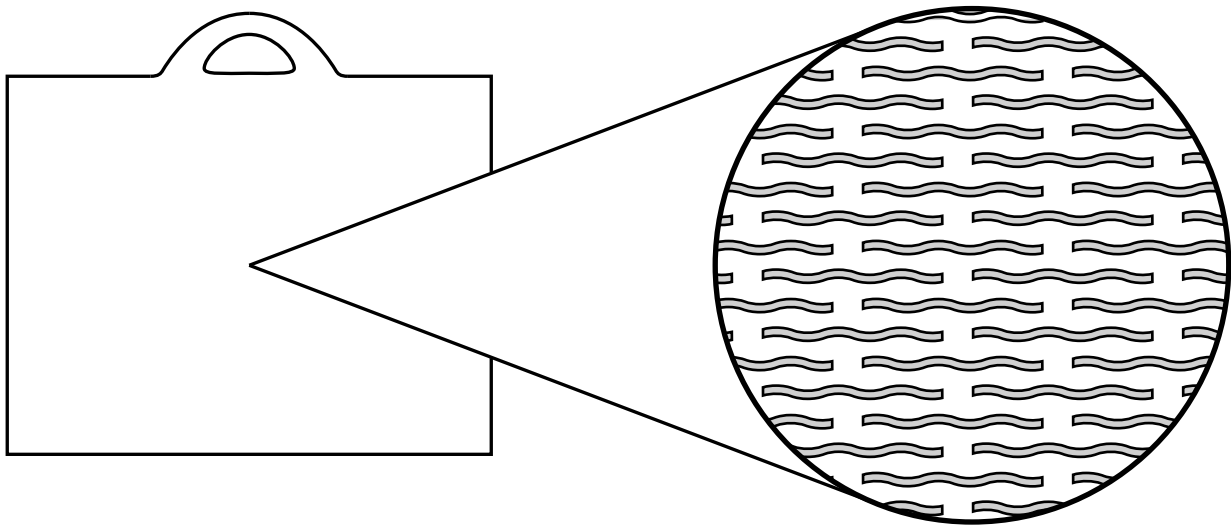
Put a tick (✓) in the box next to the correct statement.

- ☐ **The plastic stretched more when pulled down than when pulled across.**
- ☐ **The size of the force does not affect the amount of stretch.**
- ☐ **It took more force to stretch the plastic in one direction than in the other direction.**
- ☐ **For the same force, the plastic stretched down more than across.**

[1]

(b) Three students talk about their results.

Ann: “I think the polymer molecules are arranged so that they all lie in the same direction **ACROSS** the bag, as shown in this diagram.”



Sue: “I think the diagram is wrong. The polymer molecules are arranged so that they all lie in the same direction **DOWN** the bag.”

John: “I think you are both wrong. The polymer molecules are arranged randomly.”

Decide whether each student is correct or not, and show how this explains the data.



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

[6]

[TOTAL: 7]

6 The table opposite shows data from a Life Cycle Assessment for a polyester shirt and for a cotton shirt.

(a) The table shows POSITIVE figures for energy during making and using the shirts.

The table shows NEGATIVE figures for energy during disposal of the shirts.

Suggest reasons for this difference.

[2]

(b) Look at the energy and water data in the table.

Use these data to compare the sustainability of shirts made from polyester and from cotton.

Show any working.

[3]

[TOTAL: 5]

	FIBRE PRODUCTION		FABRIC WEAVING		USE (100 WASHES)		DISPOSAL BY BURNING (INCINERATION)	
	POLY-ESTER	COTTON	POLY-ESTER	COTTON	POLY-ESTER	COTTON	POLY-ESTER	COTTON
ENERGY (MJ)	97	60	33	40	340	340	-33	-7
OIL OR GAS (kg)	1.5	-	-	-	-	-	-	-
FERTILISERS (kg)	-	457	-	-	-	-	-	-
PESTICIDES (g)	-	16	-	-	-	-	-	-
WATER (dm ³)	17	22 200	1290	3900	4900	4900	-	-
CARBON DIOXIDE EMISSIONS (kg)	2.3	3.0	1.5	2.3	-	-	5.8	5.5

- 7 Some UK food labels use a ‘traffic lights’ code to show how much salt they contain.**

COLOUR	SALT CONTENT	g SALT PER 100g FOOD	RECOMMENDATION
red	high	over 1.5	eat occasionally
yellow	medium	between 0.3 and 1.5	OK to eat regularly
green	low	0.3 and below	the healthiest choice

- (a) Joe, Sally and Mary are buying food in a supermarket.**

Mary says they should use the ‘traffic lights’ code to make sure they are not eating too much salt.

Joe says the ‘traffic lights’ code is no good since it does not tell them their daily salt intake.

Sally says it does not matter what they buy as salt is good for you.

Decide whether or not each person is correct and explain why.



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

[6]

- (b) Health organisations recommend that people should not eat more than 6.0 g of salt each day.**

Many people ignore this advice and eat more than 6.0 g of salt each day.

Suggest why.

[2]

- (c) Give TWO reasons why salt is added to food.**

1

2

[2]

[TOTAL: 10]

- 8 Complete the following sentences by writing the correct words in the spaces.**

Salt deposits now found in England were formed in another part of the world when the water

in seas _____ leaving a deposit

of solid salt. The movement of

_____ plates carried these

deposits to the location that is now England,

where they are found underground. Sodium

chloride is extracted from these deposits as a

_____ from which chlorine can

be made by the process of _____ .
[4]

[TOTAL: 4]

END OF QUESTION PAPER

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