

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
June 2003



CHEMISTRY (MODULAR)
Aqueous and Organic Chemistry (Module 21)

346021

Tuesday 24 June 2003 Morning Session

In addition to this paper you will require:

- an HB pencil and a rubber;
- an 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 “Aqueous and Organic Chemistry” printed on it.
- Attempt **one Tier only, either** the Foundation Tier **or** the Higher Tier.
- Answer **all** the questions for the Tier you are attempting.
- 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.
- Mark your responses on the separate answer sheet only. Rough work may be done on the question paper.
- Mark the best responses by using a thick pencil stroke to fill in the box. Use an HB pencil. Make sure the pencil stroke does **not** extend beyond the box. Do **not** use ink or ball-point pen. If you wish to change your answer, rub out your first answer completely. See below.

Examples:

1	2	3	4
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QUESTION XXX				
xxx.1	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
xxx.2	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D
xxx.3	<input type="checkbox"/> A	<input checked="" type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D
xxx.4	<input checked="" type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input type="checkbox"/> D

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 rub 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 12 of this booklet.

FOUNDATION TIER

SECTION A

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

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

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

Mark your choices on the answer sheet.

QUESTION ONE

This question is about burning natural gas using a Bunsen burner.

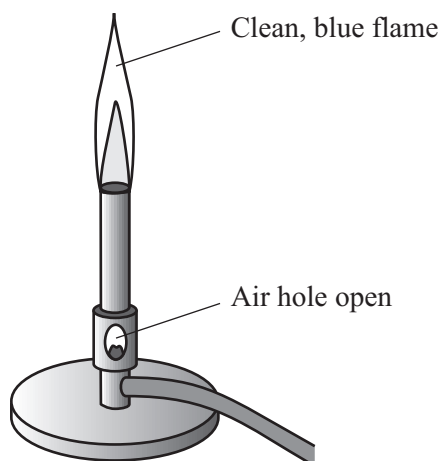
Match words from the list with each of the numbers **1–4** in the sentences.

carbon

carbon dioxide

carbon monoxide

hydrogen



When the air hole is open, the natural gas burns to produce water (vapour) and **1**

The water (vapour) is produced by oxidation of **2**

A yellow Bunsen burner flame contains particles of **3**

If natural gas burns in a limited supply of air, poisonous **4** is formed.

QUESTION TWO

This question is about four aqueous solutions of the same concentration.

Match words from the list with each of the numbers 1–4 in the table.

strong acid

strong alkali

weak acid

weak alkali

Solution	What we can say about the solution
1	it is highly ionised and accepts protons
2	it is highly ionised and donates protons
3	it is partially ionised and accepts protons
4	it is partially ionised and donates protons

QUESTION THREE

This question is about four substances that dissolve in water.

Match words from the list with each of the numbers 1–4 in the table.

ammonium nitrate

carbon dioxide

chlorine

oxygen

Substance	What we can say about the substance
1	it is an artificial fertiliser
2	it is needed for fish to survive in water
3	it is released from a fizzy drink when the can is opened
4	its solution in water will remove the colour from fabrics

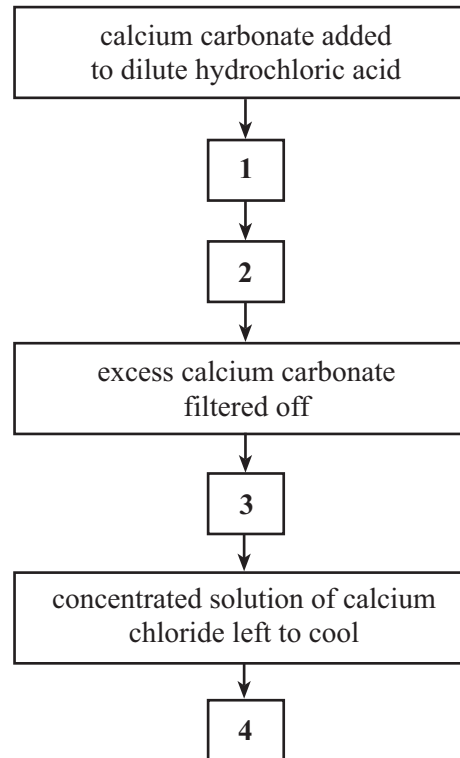
Turn over ►

QUESTION FOUR

The diagram shows stages in the preparation of the salt, calcium chloride.

Match statements **K**, **L**, **M** and **N** from the list with each of the numbers **1–4** to explain how the salt can be made.

- K** bubbles of carbon dioxide gas start to be given off
- L** calcium carbonate added until no more will react
- M** solid calcium chloride crystallises out
- N** some water evaporated from the solution of calcium chloride



QUESTION FIVE

This question is about fermentation.

Match words from the list with each of the numbers **1–4** in the sentences.

- carbon dioxide**
- enzyme**
- ethanol**
- sugar**

In the process of fermentation, yeast acts on a solution of **1**

The yeast contains biological catalysts. A biological catalyst is an **2**

A gas called **3** is produced.

An organic compound that is found in alcoholic drinks is also produced. This compound is called **4**

SECTION BQuestions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

QUESTION SIX

This question is about water.

Which **two** of the following statements are correct?**chlorine is added to drinking water to make teeth stronger****drinking water is passed through filter beds to remove bacteria****on the Earth's surface, water vapour is formed by condensation of ocean water****rain is produced when water vapour in clouds cools and condenses****water in lakes is evaporated by heat from the Sun****QUESTION SEVEN**

The table gives information about the solubility of oxygen in water.

Use this information and your knowledge of the solubility of gases to answer this question.

Temperature in °C	0	10	20	30	40	50	60
Solubility in grams per 100 grams of water	0.007	0.0055	0.004	0.0035	0.003	0.0025	0.002

Which **two** of the following statements **P**, **Q**, **R**, **S** and **T** are correct?**P** dissolved oxygen can make water hard**Q** half as much oxygen will dissolve in 100 grams of water at 30 °C than at 0 °C**R** oxygen is more soluble in hot water than in cold water**S** the solubility of oxygen in water increases as the pressure increases**T** twice as much oxygen will dissolve in 100 grams of water at 60 °C than at 20 °C**Turn over ►**

SECTION CQuestions **EIGHT** to **TEN**.

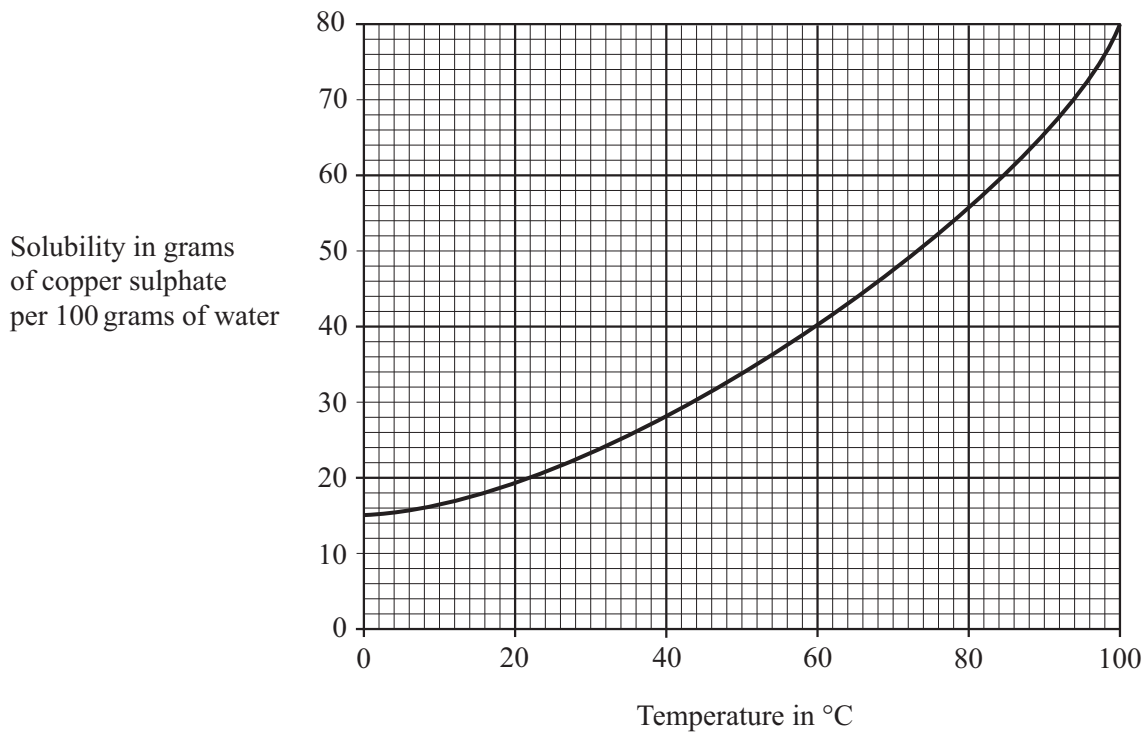
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION EIGHT

The graph shows the solubility curve for copper sulphate.

**8.1** What mass of copper sulphate will dissolve in 100 grams of water at 60 °C?

- A** 38 g
- B** 40 g
- C** 42 g
- D** 84 g

-
- 8.2** What mass of copper sulphate will dissolve in 50 grams of water at 50 °C?
- A** 17 g
 - B** 32 g
 - C** 34 g
 - D** 37 g
- 8.3** Which of the following will give a saturated solution in 100 grams of water?
- A** 22 g copper sulphate at 30 °C
 - B** 29 g copper sulphate at 40 °C
 - C** 40 g copper sulphate at 70 °C
 - D** 60 g copper sulphate at 90 °C
- 8.4** What mass of copper sulphate will crystallise out from a saturated solution in 100 grams of water as it cools from 80 °C to 50 °C?
- A** 20 g
 - B** 22 g
 - C** 54 g
 - D** 88 g

TURN OVER FOR THE NEXT QUESTION

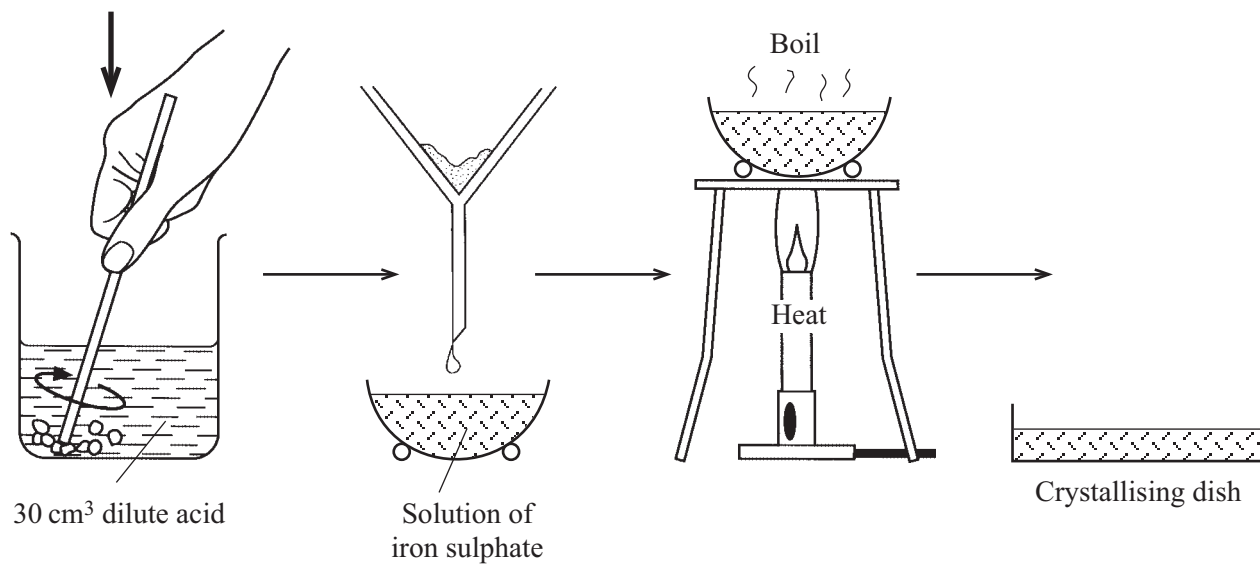
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QUESTION NINE

This question is about two salts of iron, iron sulphate and anhydrous iron chloride.

The flow diagram shows how we can make crystals of the salt, iron sulphate.

Excess iron added
a little at a time with stirring



9.1 Which acid is used to prepare iron sulphate?

- A Citric acid
- B Hydrochloric acid
- C Nitric acid
- D Sulphuric acid

9.2 The excess iron is removed from the solution of iron sulphate by

- A condensation.
- B crystallisation.
- C distillation.
- D filtration.

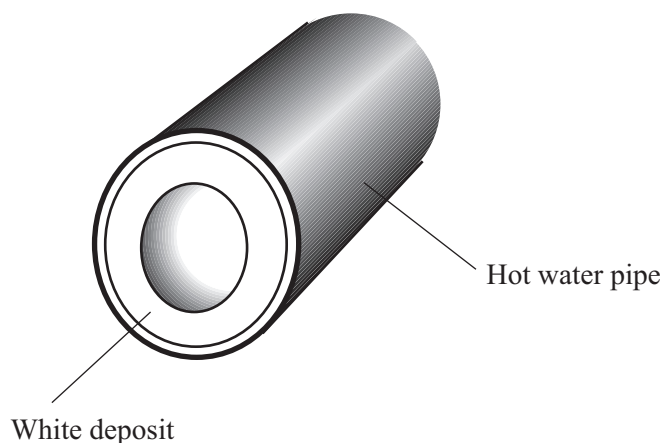
- 9.3** Anhydrous iron chloride is made by direct combination of elements.
Which elements are used?
- A** Iron and chloride
 - B** Iron and chlorine
 - C** Iron and hydrochloric acid
 - D** Iron, oxygen and chlorine
- 9.4** When making iron chloride, the elements are made to combine together by
- A** distillation.
 - B** heating.
 - C** precipitation.
 - D** using a catalyst.

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION TEN

The diagram shows the deposit inside a hot water pipe in the heating system of a house. The deposits are a disadvantage because they make the system less efficient.



10.1 The water supplied to the house has probably been collected from an area where the ground rocks contain

- A artificial fertilisers.
- B calcium compounds.
- C organic compounds.
- D sodium compounds.

10.2 A further disadvantage of this water is that

- A it cannot be used for cooking.
- B it increases tooth decay.
- C it produces too much lather in the washing machine.
- D it wastes a lot of soap before a lather is produced.

10.3 One advantage of using this water is that

- A it boils below 100 °C.
- B it can help to reduce heart disease.
- C it does not contain dissolved oxygen.
- D it does not form a scum with soap.

10.4 The water can be made softer by the addition of

- A** ammonium sulphate.
- B** chlorine.
- C** magnesium carbonate.
- D** sodium carbonate.

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 words in the list with the numbers.

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

Mark your choices on the answer sheet.

QUESTION ONE

This question is about fermentation.

Match words from the list with each of the numbers **1–4** in the sentences.

carbon dioxide

enzyme

ethanol

sugar

In the process of fermentation, yeast acts on a solution of **1**

The yeast contains biological catalysts. A biological catalyst is an **2**

A gas called **3** is produced.

An organic compound that is found in alcoholic drinks is also produced.
This compound is called **4**

QUESTION TWO

This question is about the families to which some chemical compounds belong.

Match words from the list with each of the numbers 1–4 in the table.

cholesterol

ethyl ethanoate

pentane

vitamin C

Substance	Family of substances to which it belongs
1	carboxylic acids
2	alcohols
3	alkanes
4	esters

TURN OVER FOR THE NEXT QUESTION

Turn over ►

SECTION BQuestions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

QUESTION THREE

The table gives information about the solubility of oxygen in water.

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Temperature in °C	0	10	20	30	40	50	60
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Which **two** of the following statements **P**, **Q**, **R**, **S** and **T** are correct?

- P** dissolved oxygen can make water hard
- Q** half as much oxygen will dissolve in 100 grams of water at 30 °C than at 0 °C
- R** oxygen is more soluble in hot water than in cold water
- S** the solubility of oxygen in water increases as the pressure increases
- T** twice as much oxygen will dissolve in 100 grams of water at 60 °C than at 20 °C

QUESTION FOUR

This question is about polyvinylchloride, PVC.

Which **two** statements about polyvinylchloride are correct?

it can be remoulded after heating

it is a thermosetting polymer

it is made from the monomer, ethene

it produces fumes of hydrogen cyanide when it burns

its molecules have long chains of covalently bonded atoms

TURN OVER FOR THE NEXT QUESTION

Turn over ►

SECTION CQuestions **FIVE** to **TEN**.

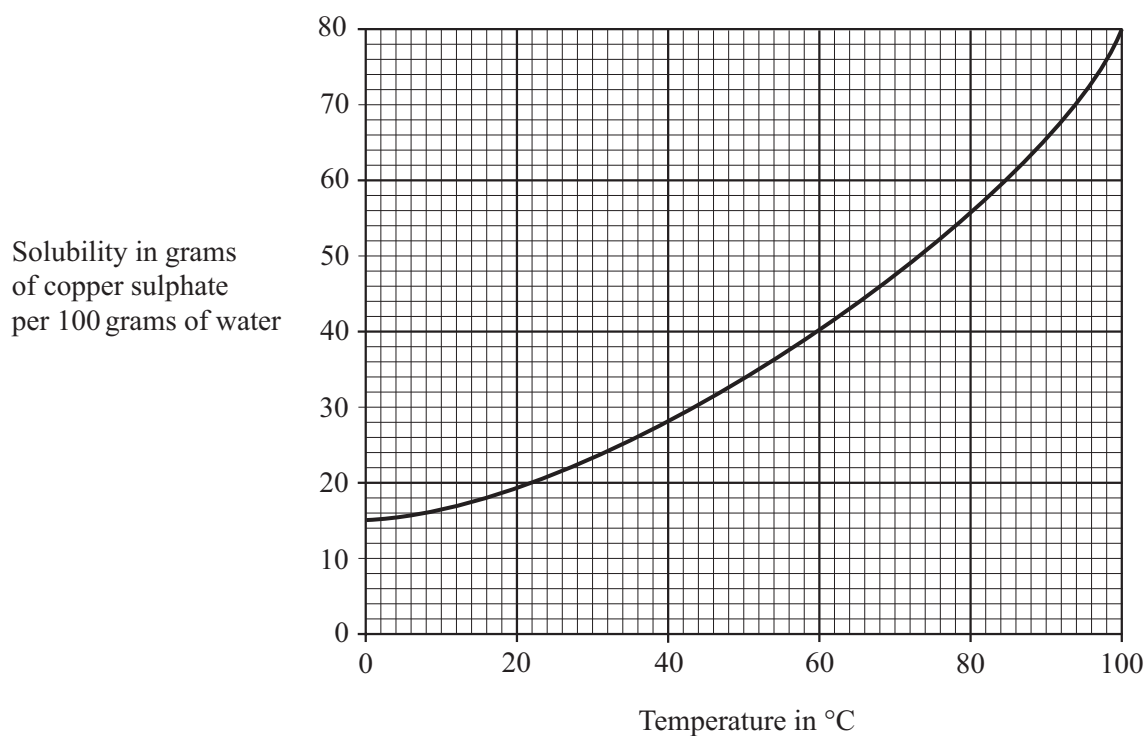
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QUESTION FIVE

The graph shows the solubility curve for copper sulphate.

**5.1** What mass of copper sulphate will dissolve in 100 grams of water at 60 °C?

- A** 38 g
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- 5.2** What mass of copper sulphate will dissolve in 50 grams of water at 50 °C?
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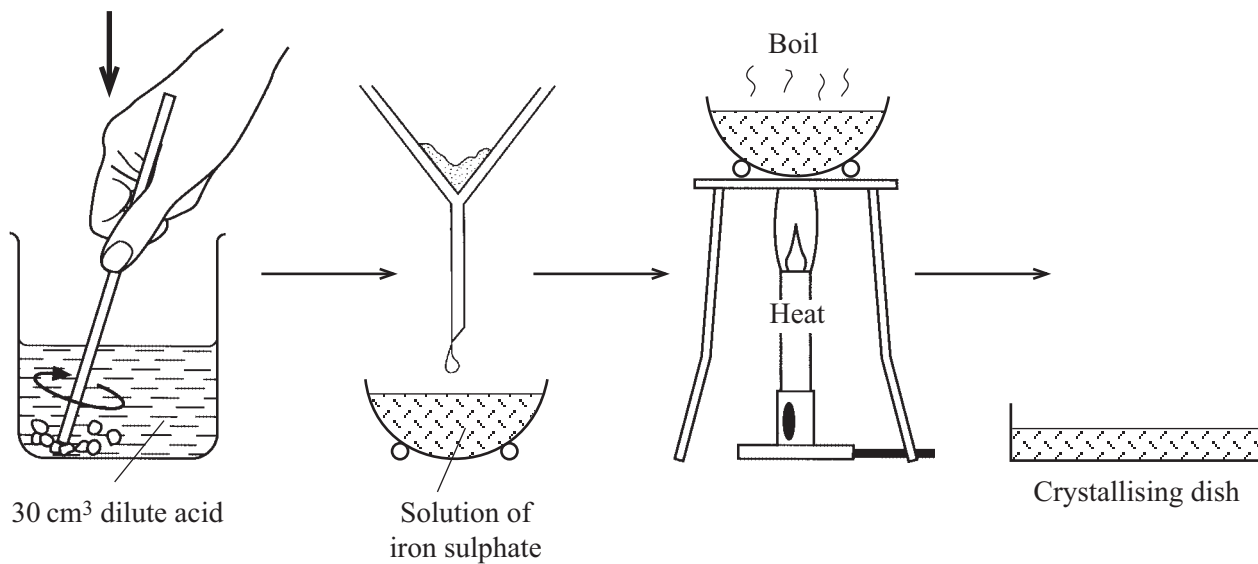
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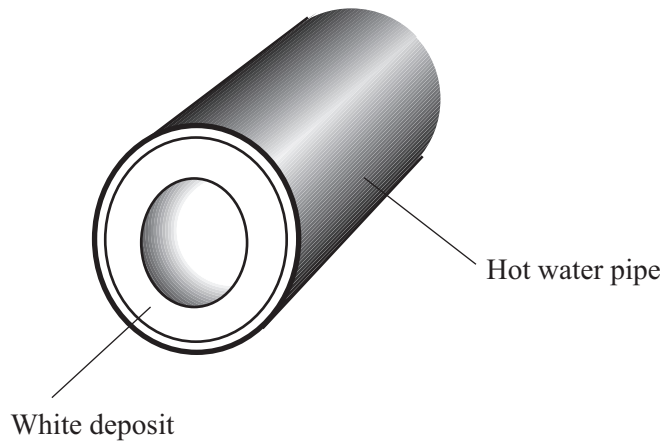
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TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION SEVEN

The diagram shows the deposit inside a hot water pipe in the heating system of a house. The deposits are a disadvantage because they make the system less efficient.



7.1 The water supplied to the house has probably been collected from an area where the ground rocks contain

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- B** calcium compounds.
- C** organic compounds.
- D** sodium compounds.

7.2 A further disadvantage of this water is that

- A** it cannot be used for cooking.
- B** it increases tooth decay.
- C** it produces too much lather in the washing machine.
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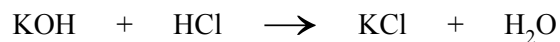
- A ammonium sulphate.
- B chlorine.
- C magnesium carbonate.
- D sodium carbonate.

TURN OVER FOR THE NEXT QUESTION

QUESTION EIGHT

Use the following information to help you to answer parts of this question.

Relative atomic masses: H = 1; O = 16; Cl = 35.5; K = 39.



A student prepares 500 cm³ of a solution of potassium hydroxide by dissolving 2.8 grams of potassium hydroxide in water.

8.1 The number of moles in 2.8 grams of potassium hydroxide is

- A 0.02
- B 0.05
- C 2.00
- D 20.00

8.2 The concentration of the potassium hydroxide solution is

- A 0.02 mol dm⁻³
- B 0.05 mol dm⁻³
- C 0.10 mol dm⁻³
- D 1.00 mol dm⁻³

In an experiment, the student finds that 25 cm³ of a 0.04 mol dm⁻³ solution of potassium hydroxide exactly reacts with 20 cm³ of a solution of hydrochloric acid.

8.3 What process did the student use to find this result?

- A Decomposition
- B Saturation
- C Substitution
- D Titration

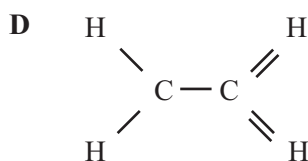
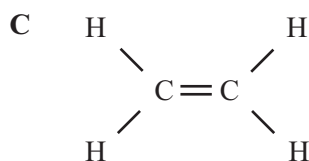
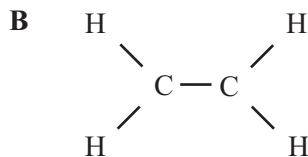
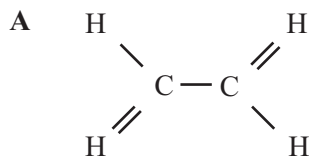
8.4 The concentration of the hydrochloric acid solution used in this experiment is

- A 0.032 mol dm⁻³
- B 0.05 mol dm⁻³
- C 0.2 mol dm⁻³
- D 20.0 mol dm⁻³

QUESTION NINE

The chemical formula for one molecule of a particular hydrocarbon is C_2H_4 .

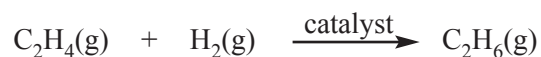
9.1 This hydrocarbon can be represented by the structural formula



9.2 The homologous series to which this hydrocarbon belongs and the general formula for the series are

	Homologous series	General formula for the series
A	alkanes	C_nH_{2n}
B	alkanes	C_nH_{2n+2}
C	alkenes	C_nH_{2n}
D	alkenes	C_nH_{2n+2}

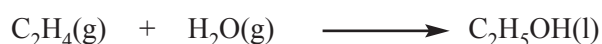
9.3 The equation shows how this hydrocarbon reacts with hydrogen.



What type of reaction is this and to which family of compounds does this product belong?

	Type of reaction	Family
A	addition	alkanes
B	decomposition	alkenes
C	reduction	esters
D	substitution	alcohols

9.4 The equation shows how the hydrocarbon reacts with steam at high temperature and pressure.



To which family of compounds does this product belong?

- A** Acids
- B** Alcohols
- C** Alkanes
- D** Alkenes

Turn over ►

QUESTION TEN

This question is about the alcohols and the carboxylic acids.



What is substance **X**?

- A** carbon dioxide
- B** carbon monoxide
- C** hydrogen
- D** water

10.2 Alcoholic drinks turn sour when the ethanol they contain is oxidised to

- A** ascorbic acid.
- B** citric acid.
- C** ethanoic acid.
- D** propanoic acid.



In this reaction, the substance produced along with the water is

- A** aspirin.
- B** cholesterol.
- C** ethyl ethanoate.
- D** methyl ethanoate.

10.4 A carboxylic acid will be neutralised by sodium hydroxide to form

- A** a salt and carbon dioxide.
- B** a salt and hydrogen.
- C** a salt and water.
- D** a salt only.

END OF TEST