

Surname					Other Names				
Centre Number					Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
Spring 2003



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

346021

Wednesday 5 March 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

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

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 16 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

Petrol is a mixture of organic compounds.

This question is about petrol being used as the fuel in a car engine.

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

carbon

carbon dioxide

carbon monoxide

hydrogen

When the petrol burns in plenty of air, the main gases in the exhaust fumes are water (vapour) and **1**

When the petrol burns in a limited supply of air, the main gases in the exhaust fumes are water (vapour) and **2** Solid particles of **3** are also given out.

Water (vapour) is produced by the oxidation of the **4** in the petrol.

QUESTION TWO

This question is about four 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	pH of the solution
1	5
2	13
3	8
4	1

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION THREE

This question is about four substances that can affect health.

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

ammonium nitrate

calcium sulphate

carbon monoxide

chlorine

Substance	How the substance can affect health
1	it reduces the amount of oxygen that the blood can carry
2	it is used to kill bacteria in drinking water
3	it helps the development of strong bones and teeth
4	it can have harmful effects on babies when present in drinking water

QUESTION FOUR

The diagram shows stages in the preparation of the salt, zinc sulphate.

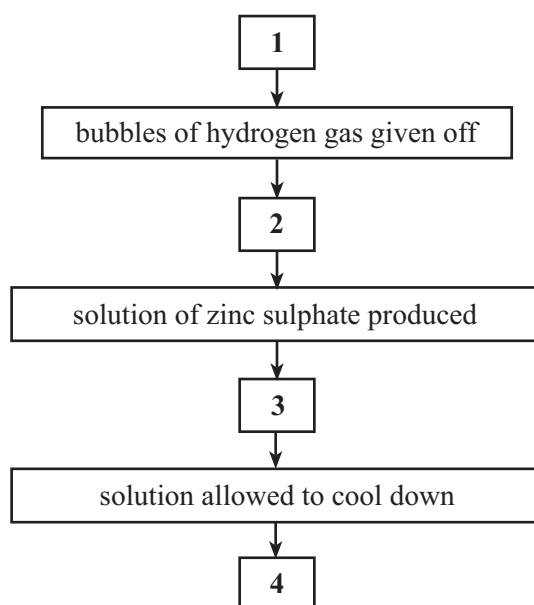
Match words from the list with each of the spaces 1–4 to explain how the salt can be made.

heated to evaporate some water

solid zinc sulphate crystallises out

unreacted zinc removed by filtering

zinc added to dilute sulphuric acid



TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION FIVE

Chemical reactions can be shown by word equations.

Choose words from the list for each of the spaces **1–4** in the word equations.

chlorine

ethanol

magnesium carbonate

nitric acid

aluminium + **1** \longrightarrow aluminium chloride

iron oxide + **2** \longrightarrow iron nitrate + water

magnesium sulphate + sodium carbonate \longrightarrow sodium sulphate + **3**

sugar $\xrightarrow{\text{action of yeast}}$ carbon dioxide + **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 acid and alkaline solutions.

Which **two** of the statements **J**, **K**, **L**, **M** and **N** are correct?

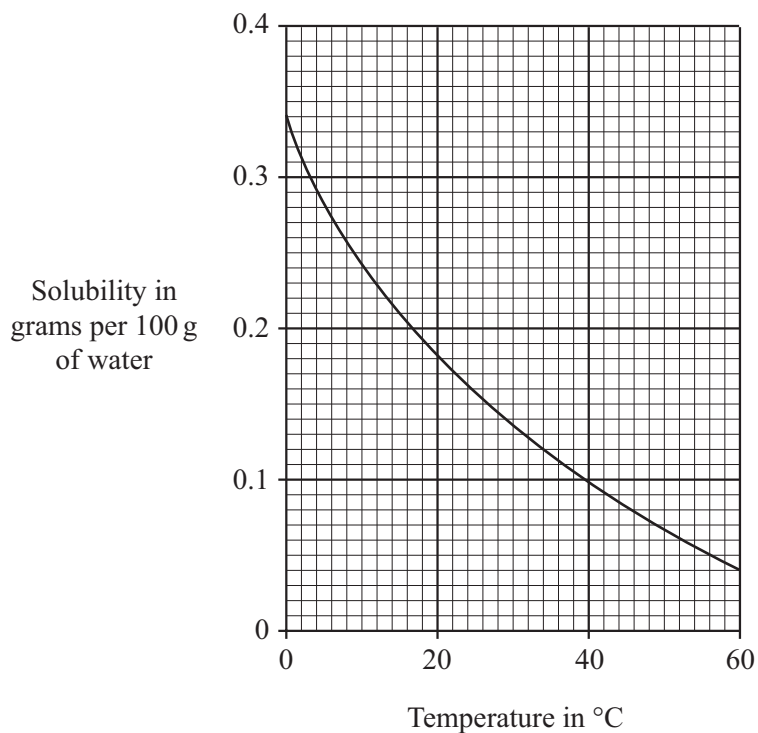
- J** ammonia in aqueous solution produces H^+ (aq) ions
- K** ammonia is a base because it can accept a proton
- L** ammonia is fully ionised in water
- M** sodium hydroxide is only partially ionised in water
- N** the H^+ (aq) ion is a proton

TURN OVER FOR THE NEXT QUESTION**Turn over ►**

QUESTION SEVEN

The graph shows information about the solubility of carbon dioxide in water.

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



Which **two** of the statements **P**, **Q**, **R**, **S** and **T** are correct?

- P** 1.2 g carbon dioxide will dissolve in 1 litre of water at 40 °C
- Q** 100 g water will dissolve 0.3 g more carbon dioxide at 0 °C than at 60 °C
- R** carbon dioxide is more soluble in hot water than in cold water
- S** carbon dioxide dissolves in water to form carbonated water
- T** the solubility of carbon dioxide in water increases as the pressure decreases

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

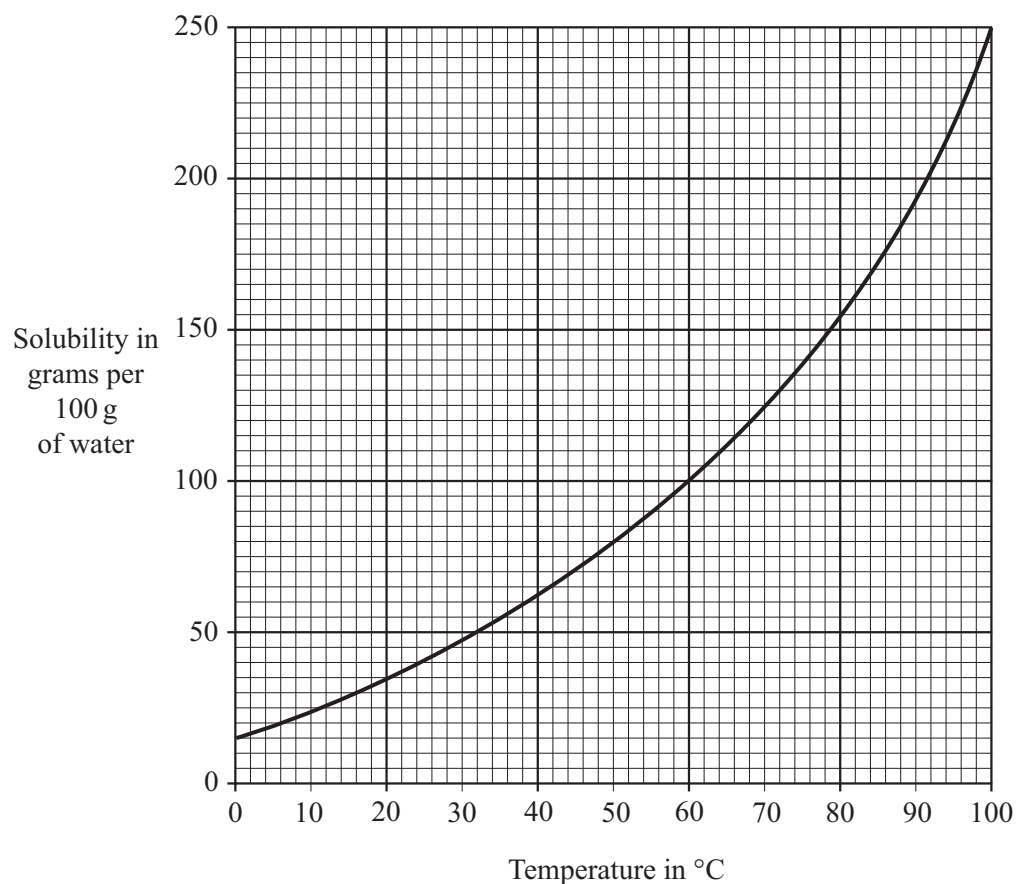
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION EIGHT

The graph shows the solubility curve for potassium nitrate.

**8.1** What mass of potassium nitrate will dissolve in 100 g of water at 50 °C?

- A** 35 g
- B** 40 g
- C** 75 g
- D** 80 g

8.2 Which of the following mixtures will be a saturated solution?

- A** 30 g potassium nitrate in 100 g of water at 20 °C
- B** 40 g potassium nitrate in 100 g of water at 30 °C
- C** 50 g potassium nitrate in 100 g of water at 40 °C
- D** 100 g potassium nitrate in 100 g of water at 60 °C

8.3 A solution contains 40 g potassium nitrate in 100 g of water at 80 °C.
The solution cools.

At what temperature will crystals of potassium nitrate begin to form?

- A** 22 °C
- B** 24 °C
- C** 50 °C
- D** 62 °C

8.4 A solution containing 40 g potassium nitrate in 100 g of water is allowed to cool to 20 °C.

What mass of potassium nitrate crystals is formed?

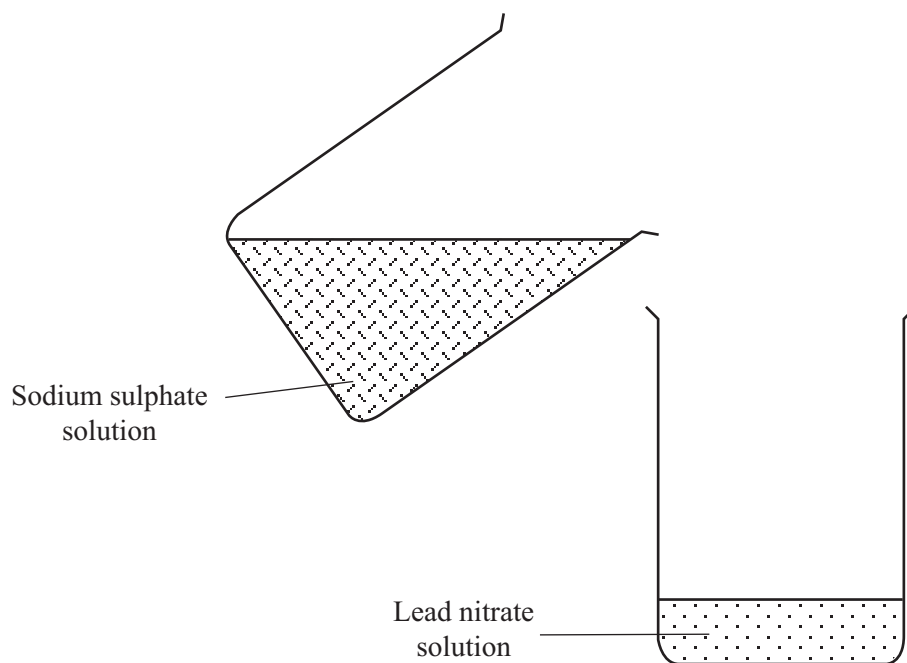
- A** 5 g
- B** 10 g
- C** 24 g
- D** 36 g

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION NINE

A student makes an insoluble lead salt by reacting together sodium sulphate solution and lead nitrate solution.



9.1 What will the student see when the two solutions are mixed and react?

- A** A blue solution
- B** Bubbles of carbon dioxide gas
- C** Bubbles of hydrogen gas
- D** A white precipitate

9.2 The student can separate and collect the insoluble lead salt by

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

9.3 What is the insoluble lead salt produced in this reaction?

- A** Lead chloride
- B** Lead nitrate
- C** Lead oxide
- D** Lead sulphate

9.4 The other product in the reaction is

- A** carbon dioxide.
- B** sodium chloride.
- C** sodium nitrate.
- D** water.

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION TEN

The table shows the results of tests on four samples of water.

50 cm³ samples of water are used in each test.

Soap flakes are added, one at a time, with shaking, to each of the 50 cm³ samples of water.

Sample	Number of soap flakes needed to produce a lather
F	18
G	8
H	16
J	2

10.1 Which of the four samples of water is the softest?

- A** Sample **F**
- B** Sample **G**
- C** Sample **H**
- D** Sample **J**

10.2 What happens when the first few soap flakes are added to Sample **F**?

- A** A lather is produced
- B** A scum is produced
- C** The water remains clear but there is no lather
- D** The water turns cloudy and a gas is given off

10.3 What happens when sodium carbonate solution is added to another 50 cm³ of Sample **H**?

- A** A lather is produced
- B** A precipitate is produced
- C** The water remains clear and a gas is given off
- D** The water turns cloudy and a gas is given off

10.4 Which ions are removed if another 50 cm³ of Sample **F** is softened by passing it through an ion exchange column?

- A** Calcium and magnesium ions
- B** Hydrogen and sodium ions
- C** Hydrogen ions only
- D** Sodium ions only

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

Chemical reactions can be shown by word equations.

Choose words from the list for each of the spaces **1–4** in the word equations.

chlorine

ethanol

magnesium carbonate

nitric acid

aluminium + **1** \longrightarrow aluminium chloride

iron oxide + **2** \longrightarrow iron nitrate + water

magnesium sulphate + sodium carbonate \longrightarrow sodium sulphate + **3**

sugar $\xrightarrow{\text{action of yeast}}$ carbon dioxide + **4**

QUESTION TWO

This question is about the substances produced in some chemical reactions.

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

ethanoic acid

hydrogen chloride

polyvinylchloride

sodium citrate

Substance	Reaction by which it can be produced
1	the oxidation of ethanol
2	the combustion of poly(chloroethene)
3	the neutralisation of citric acid by sodium carbonate
4	the polymerisation of chloroethene

TURN OVER FOR THE NEXT QUESTION

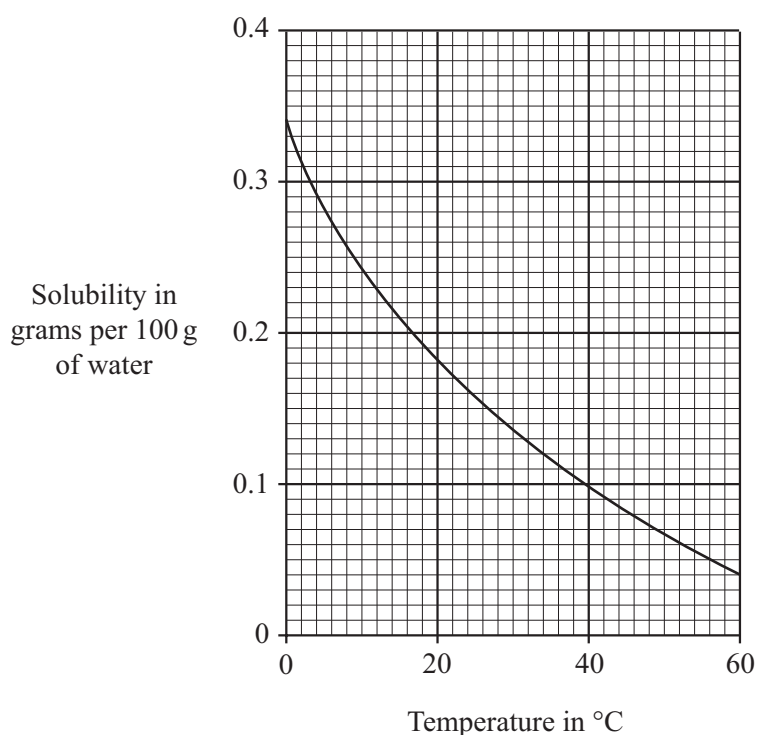
SECTION BQuestions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.

Mark your choices on the answer sheet.

QUESTION THREE

The graph shows information about the solubility of carbon dioxide in water.

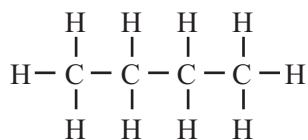
Use this information and your knowledge of solubility of gases to answer this question.

Which **two** of the statements **P**, **Q**, **R**, **S** and **T** are correct?

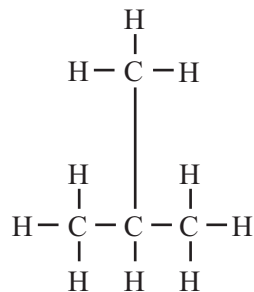
- P** 1.2 g carbon dioxide will dissolve in 1 litre of water at 40 °C
- Q** 100 g water will dissolve 0.3 g more carbon dioxide at 0 °C than at 60 °C
- R** carbon dioxide is more soluble in hot water than in cold water
- S** carbon dioxide dissolves in water to form carbonated water
- T** the solubility of carbon dioxide in water increases as the pressure decreases

QUESTION FOUR

The diagram shows two isomers of butane.



n-butane



iso-butane

Which **two** statements about these isomers are correct?

intermolecular forces in the two isomers are of the same strength

n-butane burns to produce carbon dioxide but iso-butane produces carbon monoxide

n-butane has the higher boiling point

they have the same boiling point

they have the same chemical formula

TURN OVER FOR THE NEXT QUESTION

Turn over ►

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

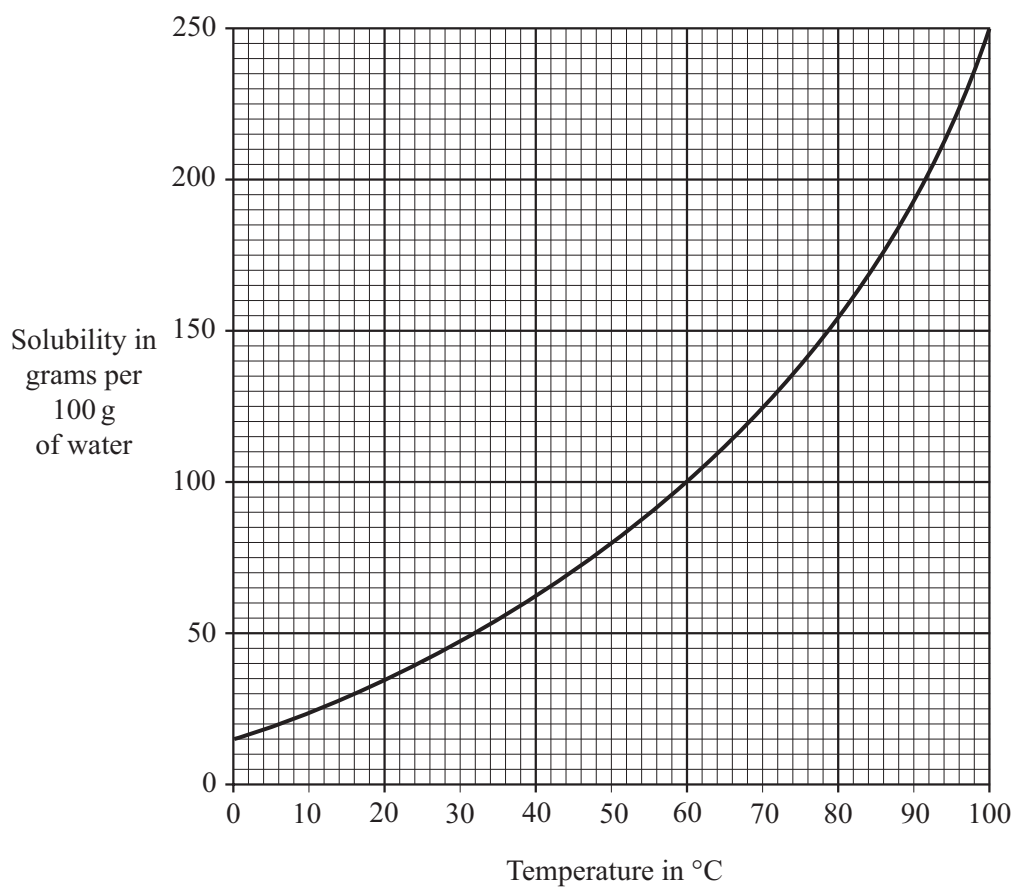
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION FIVE

The graph shows the solubility curve for potassium nitrate.

**5.1** What mass of potassium nitrate will dissolve in 100 g of water at 50 °C?

- A** 35 g
- B** 40 g
- C** 75 g
- D** 80 g

5.2 Which of the following mixtures will be a saturated solution?

- A** 30 g potassium nitrate in 100 g of water at 20 °C
- B** 40 g potassium nitrate in 100 g of water at 30 °C
- C** 50 g potassium nitrate in 100 g of water at 40 °C
- D** 100 g potassium nitrate in 100 g of water at 60 °C

5.3 A solution contains 40 g potassium nitrate in 100 g of water at 80 °C.
The solution cools.

At what temperature will crystals of potassium nitrate begin to form?

- A** 22 °C
- B** 24 °C
- C** 50 °C
- D** 62 °C

5.4 A solution containing 40 g potassium nitrate in 100 g of water is allowed to cool to 20 °C.

What mass of potassium nitrate crystals is formed?

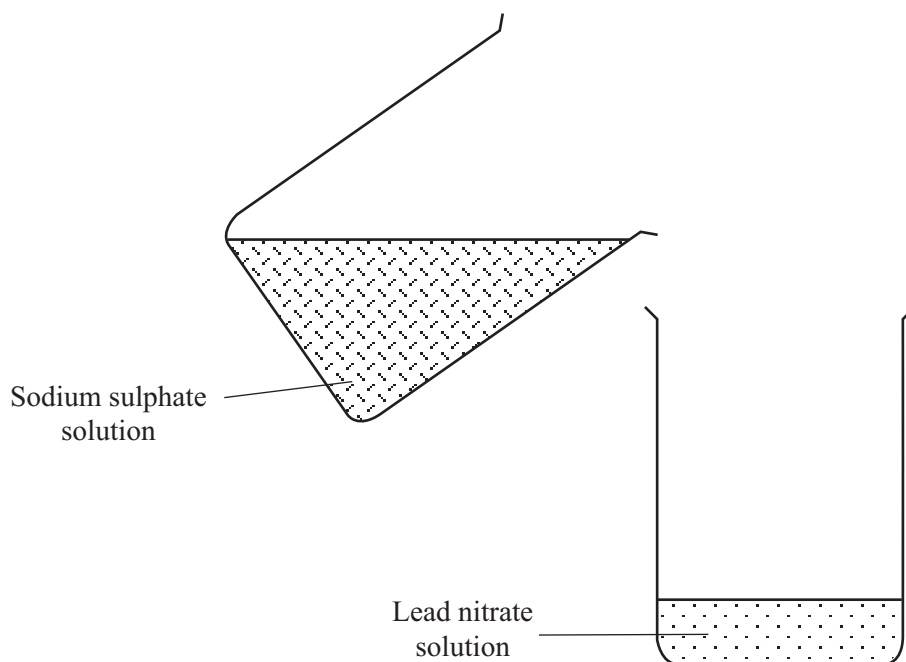
- A** 5 g
- B** 10 g
- C** 24 g
- D** 36 g

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION SIX

A student makes an insoluble lead salt by reacting together sodium sulphate solution and lead nitrate solution.



6.1 What will the student see when the two solutions are mixed and react?

- A** A blue solution
- B** Bubbles of carbon dioxide gas
- C** Bubbles of hydrogen gas
- D** A white precipitate

6.2 The student can separate and collect the insoluble lead salt by

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

6.3 What is the insoluble lead salt produced in this reaction?

- A** Lead chloride
- B** Lead nitrate
- C** Lead oxide
- D** Lead sulphate

6.4 The other product in the reaction is

- A** carbon dioxide.
- B** sodium chloride.
- C** sodium nitrate.
- D** water.

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION SEVEN

The table shows the results of tests on four samples of water.

50 cm³ samples of water are used in each test.

Soap flakes are added, one at a time, with shaking, to each of the 50 cm³ samples of water.

Sample	Number of soap flakes needed to produce a lather
F	18
G	8
H	16
J	2

- 7.1** Which of the four samples of water is the softest?
- A** Sample **F**
 - B** Sample **G**
 - C** Sample **H**
 - D** Sample **J**
- 7.2** What happens when the first few soap flakes are added to Sample **F**?
- A** A lather is produced
 - B** A scum is produced
 - C** The water remains clear but there is no lather
 - D** The water turns cloudy and a gas is given off
- 7.3** What happens when sodium carbonate solution is added to another 50 cm³ of Sample **H**?
- A** A lather is produced
 - B** A precipitate is produced
 - C** The water remains clear and a gas is given off
 - D** The water turns cloudy and a gas is given off

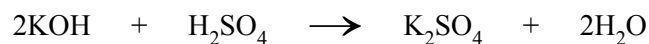
- 7.4 Which ions are removed if another 50 cm³ of Sample F is softened by passing it through an ion exchange column?
- A Calcium and magnesium ions
 - B Hydrogen and sodium ions
 - C Hydrogen ions only
 - D Sodium ions only

TURN OVER FOR THE NEXT QUESTION

QUESTION EIGHT

You may find the following information useful when answering parts of this question.

Relative atomic masses: K = 39; O = 16; H = 1; S = 32

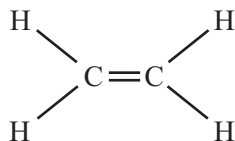


A student finds that 25 cm³ of a 0.04 mol dm⁻³ solution of potassium hydroxide is exactly neutralised by 20 cm³ of a solution of sulphuric acid.

- 8.1** What mass of potassium hydroxide is dissolved in 25 cm³ of a 0.04 mol dm⁻³ solution of potassium hydroxide?
- A** 0.028 g
B 0.056 g
C 1.4 g
D 2.24 g
- 8.2** What method could the student use to find the exact volume of the sulphuric acid solution required to neutralise the potassium hydroxide solution?
- A** Crystallisation
B Precipitation
C Saturation
D Titration
- 8.3** The concentration of the sulphuric acid solution is
- A** 0.025 mol dm⁻³
B 0.032 mol dm⁻³
C 0.25 mol dm⁻³
D 0.50 mol dm⁻³
- 8.4** How much potassium sulphate could be produced from a solution containing 5.6 g of potassium hydroxide, by reaction with sulphuric acid?
- A** 1.55 g
B 2.80 g
C 3.60 g
D 8.70 g

QUESTION NINE

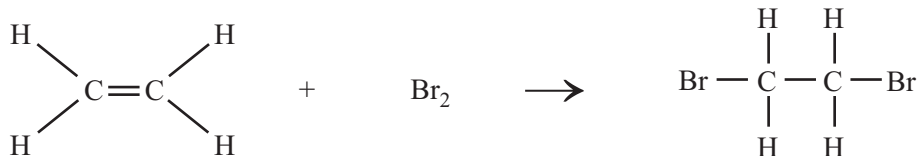
The structural formula represents one molecule of a hydrocarbon.



9.1 When this hydrocarbon burns in a plentiful supply of air, the two products are

- A carbon and water.
- B carbon dioxide and hydrogen.
- C carbon dioxide and water.
- D carbon monoxide and water.

9.2 The equation shows the reaction between this hydrocarbon and bromine water.



This is

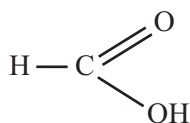
- A an addition reaction.
 - B a decomposition reaction.
 - C an oxidation reaction.
 - D a substitution reaction.
- 9.3 At high temperature and pressure and using a suitable catalyst, this hydrocarbon will react with hydrogen to produce
- A an alcohol.
 - B an alkane.
 - C an alkene.
 - D a carboxylic acid.
- 9.4 Ethanol is produced at high pressure and moderately high temperature, using a catalyst, by reacting this hydrocarbon with
- A carbon dioxide.
 - B oxygen.
 - C phosphoric acid.
 - D steam.

Turn over ►

QUESTION TEN

The carboxylic acids form a homologous series.

10.1 A particular carboxylic acid is represented by this structural formula.



What is the name of this carboxylic acid?

- A** Butanoic acid
 - B** Ethanoic acid
 - C** Methanoic acid
 - D** Propanoic acid
- 10.2** Ethanoic acid reacts with sodium hydroxide to produce
- A** sodium ethanoate and carbon dioxide.
 - B** sodium ethanoate and hydrogen.
 - C** sodium ethanoate, carbon dioxide and water.
 - D** sodium ethanoate and water.
- 10.3** $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$

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

- A** an alcohol.
 - B** an alkene.
 - C** an ester.
 - D** a salt.
- 10.4** $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$

The \rightleftharpoons sign indicates that the reaction is

- A** a catalysed reaction.
- B** a redox reaction.
- C** a reversible reaction.
- D** an oxidation reaction.

END OF TEST