



Rewarding Learning

ADVANCED  
General Certificate of Education  
2013

Centre Number

71

Candidate Number

## Chemistry

Assessment Unit A2 3  
Internal Assessment  
Practical Examination 1

[AC231]

WEDNESDAY 15 MAY, MORNING



### TIME

2 hours 30 minutes.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all three** questions.

Write your answers in the spaces provided.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 70.

Questions 1 and 2 are practical exercises each worth 25 marks.

Question 3 is a planning exercise worth 20 marks.

Quality of written communication will be assessed in **Questions 3(d) and (e)**.

**You may not have access to notes, textbooks and other material to assist you.**

A Periodic Table of the Elements, containing some data, is included in this question paper.

For Examiner's use only		
Question Number	Marks	Moderation Mark
1		
2		
3		
<b>Total Marks</b>		







## 2 Observation/deduction

Safety glasses must be worn at all times and care should be exercised during this practical examination.

- (a) You are provided with a salt, labelled X. Carry out the following tests. Record your observations and deductions in the spaces below.

Test	Observations	Deductions
1 Describe the appearance of X.	[1]	[1]
2 Add a spatula measure of X to 50 cm <sup>3</sup> of deionised water and stir until there is no further change.	[1]	[1]
3 Add 5 drops of silver nitrate solution to a test tube containing 2 cm <sup>3</sup> of the solution of X. Allow the mixture to stand.	[3]	[1]
4 Put 2 cm <sup>3</sup> of the solution of X into a test tube.  (a) Add 5 drops of sodium hydroxide solution.  (b) Add a further 5 cm <sup>3</sup> of sodium hydroxide solution.	[3]	[3]
5 Place a spatula measure of solid X in a dry boiling tube and heat gently.	[2]	[1]

Give the name of compound X

\_\_\_\_\_ [2]

Teacher Mark	Examiner Check	Remark

- (b) You are provided with an organic liquid containing one functional group, labelled Y. Carry out the following tests and record your observations and deductions in the spaces below. The mass spectrum of Y is also provided.

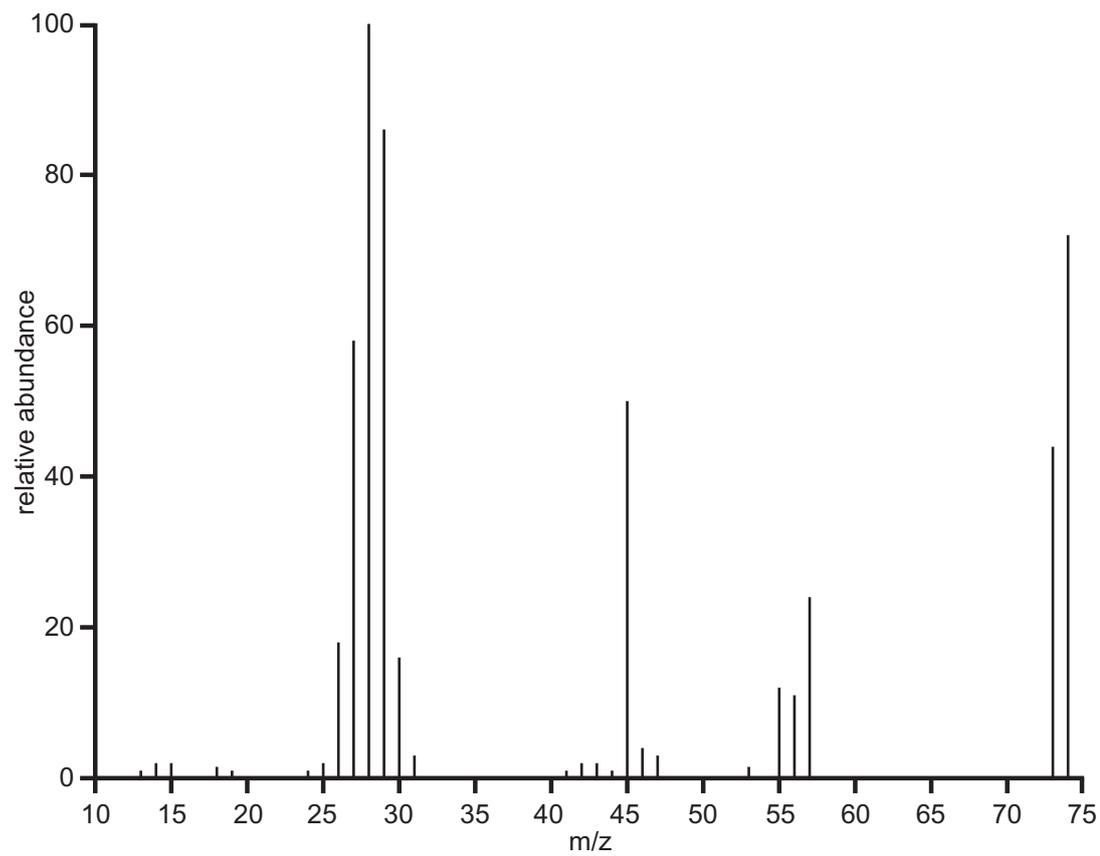
Test	Observations	Deductions
<p><b>1</b> Place 2 cm<sup>3</sup> of Y into a boiling tube. Place in a test tube rack.</p> <p><b>(a)</b> Under supervision, cautiously add a very small measure of phosphorus(V) chloride in a fume cupboard.</p> <p><b>(b)</b> In a fume cupboard, hold the stopper of a bottle of concentrated ammonia solution over the boiling tube used in test 1(a).</p>	[2]	[1]
<p><b>2</b> Place 2 cm<sup>3</sup> of Y into a test tube. Add 1 cm<sup>3</sup> of sodium carbonate solution.</p>	[1]	[1]

- (i) What homologous series does Y belong to?

\_\_\_\_\_ [1]

Teacher Mark	Examiner Check	Remark

Use the following mass spectrum to deduce the structure of Y.



(ii) Draw the structure of Y below.

[1]

Maximum [25] marks

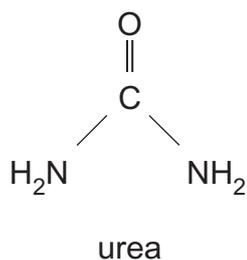
Teacher Mark	Examiner Check	Remark

### 3 Planning exercise

#### Preparation of urea

Urea,  $(\text{NH}_2)_2\text{CO}$ , was first synthesised by Friedrich Wöhler in 1828. Today some seven million tons of urea are produced per year mainly for use as a fertiliser.

Urea can be prepared in the laboratory by reacting lead(II) cyanate,  $\text{Pb}(\text{CNO})_2$ , with ammonia and water to produce lead(II) hydroxide and ammonium cyanate,  $\text{NH}_4\text{CNO}$ . The ammonium cyanate then rearranges when heated to form urea, which has a melting point of  $133^\circ\text{C}$ .



- (a) Write an equation for the reaction of lead(II) cyanate with ammonia and water.

\_\_\_\_\_ [2]

- (b) Assuming a 70% yield, calculate the mass of lead(II) cyanate required to produce 450 g of ammonium cyanate.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

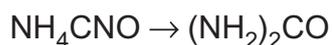
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [4]

Teacher Mark	Examiner Check	Remark

- (c) The ammonium cyanate rearranges to form urea as shown in the equation below.



- (i) The crude product is purified by dissolving in the minimum volume of hot ethanol, filtering to remove insoluble impurities, and cooling. What name is given to this purification process?

\_\_\_\_\_ [1]

- (ii) What practical considerations determine the choice of solvent used?

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (iii) Why is the minimum amount of hot ethanol used?

\_\_\_\_\_ [1]

- (iv) How is the pure dry product obtained from the filtrate?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

Quality of written communication will be assessed in parts (d) and (e).

- (d) Giving practical details, describe how you would determine whether or not the crystals of urea produced are pure.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

Teacher Mark	Examiner Check	Remark

- (e) How could you use the following infrared spectroscopic data to follow the progress of the rearrangement of ammonium cyanate to urea?

Bond	Wave number/cm <sup>-1</sup>
C = O	1650
C ≡ N	2100
N-H (in amines)	3200–3500

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[3]

Quality of written communication

[2]

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**THIS IS THE END OF THE QUESTION PAPER**

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Teacher Mark	Examiner Check	Remark



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**Chemistry**  
**Assessment Unit A2 3**

*Internal Assessment*

Practical Examinations 1 and 2

**[AC231] [AC232]**

**WEDNESDAY 15 MAY AND THURSDAY 16 MAY**

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AC231 AC232

**APPARATUS**  
**AND**  
**MATERIALS**  
**LIST**

### Advice for centres

- All chemicals used should be at least laboratory reagent specification and labelled with appropriate safety symbols, e.g. irritant.
- For centres running multiple sessions – candidates for the later session should be supplied with clean, dry glassware. If it is not feasible then glassware from the first session should be thoroughly washed, rinsed with deionised water and allowed to drain.
- **Ensure all chemicals are in date otherwise expected observations may not be seen.**

## Apparatus and Materials List

### Practical Examination 1

Each candidate must be supplied with safety goggles or glasses.

#### Question 1

Each candidate must be supplied with:

- one 50 cm<sup>3</sup> burette of at least class B quality
- a funnel for filling the burette
- a retort stand and clamp
- two small beakers
- one 25 cm<sup>3</sup> pipette of at least class B quality
- a safety pipette filler
- three conical flasks 250 cm<sup>3</sup> capacity
- a white tile or white paper
- a wash bottle containing deionised/distilled water
- Eriochrome Black T indicator solution labelled **Eriochrome Black T, corrosive, use 4 drops**, made by adding 0.2 g of solid Eriochrome Black T to 30 cm<sup>3</sup> of concentrated ammonia solution and 10 cm<sup>3</sup> of ethanol. This should be made up the day before the examination and should stay in the fume cupboard with droppers available.
- 150 cm<sup>3</sup> of 0.01 mol dm<sup>-3</sup> edta solution labelled **edta solution 0.01 mol dm<sup>-3</sup>**, made by diluting an existing 0.1 M solution or by dissolving 18.6 g of the solid hydrated disodium salt of EDTA to 5 dm<sup>3</sup> with deionised water. The formula of this salt is [CH<sub>2</sub>N(CH<sub>2</sub>COOH).CH<sub>2</sub>COONa]<sub>2</sub>.2H<sub>2</sub>O and it has M<sub>R</sub> = 372.
- 150 cm<sup>3</sup> of approximately 0.01 mol dm<sup>-3</sup> solution of Ca<sup>2+</sup> labelled **hard water**, made by dissolving 10.0 g of CaCl<sub>2</sub>.6H<sub>2</sub>O in 5 dm<sup>3</sup> of deionised water.
- pH 10 buffer solution 4 × 10 cm<sup>3</sup> portions labelled **pH 10 buffer solution**.
- A conical flask containing 30 cm<sup>3</sup> 0.01M edta, 30 cm<sup>3</sup> deionised water, 4 drops of Eriochrome Black T indicator, labelled **end point colour reference** (made up on the morning of the practical examination).

Appropriate amounts should be prepared for the total number of candidates taking the examination.

## Question 2

Each candidate must be supplied with:

- a small beaker
- four test tubes
- two boiling tubes
- a test tube holder
- a test tube rack
- a spatula
- a stirring rod
- a heat-proof mat
- a Bunsen burner
- several plastic droppers
- about 3.0 g of hydrated chromium(III) chloride ( $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ ), labelled **X**.
- about  $10\text{ cm}^3$  of sodium hydroxide solution in a reagent bottle/beaker labelled **sodium hydroxide solution**. This solution should be approximately  $2\text{ mol dm}^{-3}$ .
- about  $10\text{ cm}^3$  of silver nitrate solution in a reagent bottle/beaker labelled **silver nitrate solution**. This solution should be approximately  $0.1\text{ mol dm}^{-3}$  ( $17.0\text{ g dm}^{-3}$ ).
- about  $10\text{ cm}^3$  of ethanoic acid solution in a stoppered container labelled **Y**. This solution should be approximately  $1\text{ mol dm}^{-3}$ .
- about  $10\text{ cm}^3$  of sodium carbonate solution labelled **sodium carbonate solution**. This solution should be approximately 1M.
- a reagent bottle containing concentrated ammonia solution labelled **concentrated ammonia solution** and **irritant** (placed in fume cupboard).
- access to phosphorus(V) chloride\*, labelled **phosphorus(V) chloride** and **harmful**, and placed in fume cupboard with gloves provided.

\***Safety note:** test 2(b) part 1(a) involving  $\text{PCl}_5$  – the amount of  $\text{PCl}_5$  used must be **very** small, it must remain in the fume cupboard away from water, and be in a vessel that is easy to open and is closed after use. Students should carry out test 2(b) part 1(a) under close supervision.

Appropriate amounts should be prepared for the total number of candidates taking the examination.

## Practical Examination 2

Each candidate must be supplied with safety goggles or glasses.

### Question 1

Each candidate must be supplied with:

- one 50 cm<sup>3</sup> burette of at least class B quality
- a funnel for filling the burette
- a retort stand and clamp
- two small beakers
- one 25 cm<sup>3</sup> pipette of at least class B quality
- a safety pipette filler
- three conical flasks of 250 cm<sup>3</sup> capacity
- a white tile or white paper
- a wash bottle containing deionised/distilled water
- Eriochrome Black T indicator solution labelled **Eriochrome Black T, corrosive, use 4 drops**, made by adding 0.2 g of solid Eriochrome Black T to 30 cm<sup>3</sup> of concentrated ammonia solution and 10 cm<sup>3</sup> of ethanol. This should be made up the day before the examination and should stay in the fume cupboard with droppers available.
- 150 cm<sup>3</sup> of 0.01 mol dm<sup>-3</sup> edta solution labelled **edta solution 0.02 mol dm<sup>-3</sup>**, made by diluting an existing 0.1 M solution or by dissolving 18.6 g of the solid hydrated disodium salt of EDTA to 5 dm<sup>3</sup> with deionised water. The formula of this salt is [CH<sub>2</sub>N(CH<sub>2</sub>COOH).CH<sub>2</sub>COONa]<sub>2</sub>.2H<sub>2</sub>O and it has M<sub>R</sub> = 372.
- 150 cm<sup>3</sup> of approximately 0.01 mol dm<sup>-3</sup> solution of Ca<sup>2+</sup> labelled **hard water**, made by dissolving 10.0 g of CaCl<sub>2</sub>.6H<sub>2</sub>O in 5 dm<sup>3</sup> of deionised water.
- pH 10 buffer solution 4 × 10 cm<sup>3</sup> portions labelled **pH 10 buffer solution**.
- A conical flask containing 30 cm<sup>3</sup> 0.01M edta, 30 cm<sup>3</sup> deionised water, 4 drops of Eriochrome Black T indicator, labelled **end point colour reference** (made up on the morning of the practical examination).

Appropriate amounts should be prepared for the total number of candidates taking the examination.

## Question 2

Each candidate must be supplied with:

- a small beaker
- four test tubes
- two boiling tubes
- a test tube holder
- a test tube rack
- a spatula
- a stirring rod
- a heat-proof mat
- a Bunsen burner
- several plastic droppers
- about 3.0 g of hydrated manganese chloride ( $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ ), labelled **R**. (This should be freshly opened as it oxidises).
- about  $10\text{ cm}^3$  of sodium hydroxide solution in a reagent bottle/beaker labelled **sodium hydroxide solution**. This solution should be approximately  $2\text{ mol dm}^{-3}$ .
- about  $10\text{ cm}^3$  of silver nitrate solution in a reagent bottle/beaker labelled **silver nitrate solution**. This solution should be approximately  $0.1\text{ mol dm}^{-3}$  ( $17.0\text{ g dm}^{-3}$ ).
- about  $10\text{ cm}^3$  of ethanoic acid solution in a stoppered container labelled **S**. This solution should be approximately  $1\text{ mol dm}^{-3}$ .
- about  $10\text{ cm}^3$  of sodium carbonate solution labelled **sodium carbonate solution**. This solution should be approximately 1M.
- a reagent bottle containing concentrated ammonia solution labelled **concentrated ammonia solution** and **irritant** (placed in fume cupboard).
- access to phosphorus(V) chloride\*, labelled **phosphorus(V) chloride** and **harmful**, and placed in fume cupboard with gloves provided.

\***Safety note:** test 2(b) part 1(a) involving  $\text{PCl}_5$  – the amount of  $\text{PCl}_5$  used must be **very** small, it must remain in the fume cupboard away from water, and be in a vessel that is easy to open and is closed after use. Students should carry out test 2(b) part 1(a) under close supervision.

Appropriate amounts should be prepared for the total number of candidates taking the examination.







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## **Chemistry**

Assessment Unit A2 3

*Internal Assessment*

Practical Examinations 1 and 2

**[AC231] [AC232]**

**WEDNESDAY 15 AND THURSDAY 16 MAY**

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# **Confidential Instructions to the Supervisor of the Practical Examination**

## INSTRUCTIONS TO THE SUPERVISOR OF THE PRACTICAL EXAMINATION

### General

1. The instructions contained in this document are for the use of the Supervisor **and are strictly confidential**. Under no circumstances may information concerning apparatus or materials be given before the examination to a candidate or other unauthorised person.
2. In a centre with a large number of candidates it may be necessary for two or more examination sessions to be organised. **It is the responsibility of the schools to ensure that there should be no contact between candidates taking each session.**
3. A suitable laboratory must be reserved for the examination and kept locked throughout the period of preparation. Unauthorised persons not involved in the preparation for the examination must not be allowed to enter. Candidates must not be admitted until the specified time for commencement of the examination.
4. The Supervisor must ensure that the solutions provided for the candidates are of the nature and concentrations specified in the Apparatus and Materials List.
5. **The Supervisor is to be granted access to the Teacher's Copy of the Question Paper, showing parts of questions 1 and 2 only, on Friday 10 May 2013.** The Supervisor is asked to check, at the earliest opportunity, that the experiments and tests in the question paper may be completed satisfactorily using the apparatus, materials and solutions that have been assembled. **This question paper must then be returned to safe custody** at the earliest possible moment after the Supervisor has ensured that all is in order. **No access to the question paper should be allowed before 10 May 2013.**
6. In the case of centres who have candidates entered for both practical examinations, the Supervisor must **return all unused scripts of Practical Examination 1** to the Examinations Officer immediately on completion of the examination. **The contents of this examination must be kept confidential until the completion of Practical Examination 2.**
7. Pipettes and burettes should be checked before the examination, and there should be an adequate supply of spare apparatus in case of breakages. The Apparatus and Materials List should be regarded as a minimum and there should be no objection to candidates being supplied with more than the minimum amount of apparatus and materials.
8. **Candidates may not use text books and laboratory notes for reference during the examination, and must be informed of this beforehand.**

9. Clear instructions must be given by the Supervisor to all candidates at the beginning of the examination concerning appropriate safety procedures and precautions. Supervisors are also advised to remind candidates that all substances in the examination must be treated with caution. **Only those tests specified in the question paper should be attempted. Candidates must not attempt any additional confirmatory tests.** Anything spilled on the skin should be washed off immediately with plenty of water. The use of appropriate eye protection is essential.
10. Supervisors are reminded that they may not assist candidates during the examination. However, if in the opinion of the Supervisor, a candidate is about to do something which may endanger him/herself or others, the Supervisor should intervene. A full written report must be sent to CCEA at once.
11. Upon request, a candidate may be given additional quantities of materials (answer paper, reagents and unknowns) without penalty. No notification need be sent to CCEA.
12. The examination room must be cleared of candidates immediately after the examination.
13. No materials will be supplied by CCEA.









