Rewarding Learning

Centre Number

71

Candidate Number

ADVANCED
General Certificate of Education
2013

Chemistry

Assessment Unit A2 3
Internal Assessment
Practical Examination 1

[AC231]

MV18

WEDNESDAY 15 MAY, MORNING

TIME

2 hours 30 minutes, plus your additional time allowance.

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.

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(Questions start overleaf)

1 Titration exercise

Hardness in water may be caused by the presence of dissolved calcium ions.

You are provided with:

A solution of edta of concentration 0.01 mol dm^{-3}
A sample of hard water
Four portions of pH10 buffer solution
Eriochrome Black T indicator solution **(use four drops)**
A sample solution showing the colour at the end point

Assuming that all apparatus is clean and dry, you are required to carry out a titration and use your results to determine the concentration of calcium ions in the hard water sample.

(a) Give details of the procedure you intend to use. The edta solution should go into the burette. [6]

(b) Carry out your procedure. Present your results in a suitable table and calculate the average titre. [8]

(c) State the colour change at the end point of the titration. [2]

From _____ to _____

(d) With reference to the following equation explain the reason for adding the pH10 buffer to the reaction mixture. [2]

$$Ca^{2+} + H_2(edta)^{2-} \rightleftharpoons [Ca(edta)]^{2-} + 2H^+$$

(e) Calculate the concentration of the calcium ions in the hard water in $mg\,dm^{-3}$. [5]

(f) Name another test that would be used to confirm the presence of calcium ions in the hard water, stating the expected result. [2]

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(Questions continue overleaf)

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^3 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^3 of the solution of X. Allow the mixture to stand.	[3]	[1]

4 Put 2 cm^3 of the solution of X into a test tube. **(a)** Add 5 drops of sodium hydroxide solution. **(b)** Add a further 5 cm^3 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]

_____

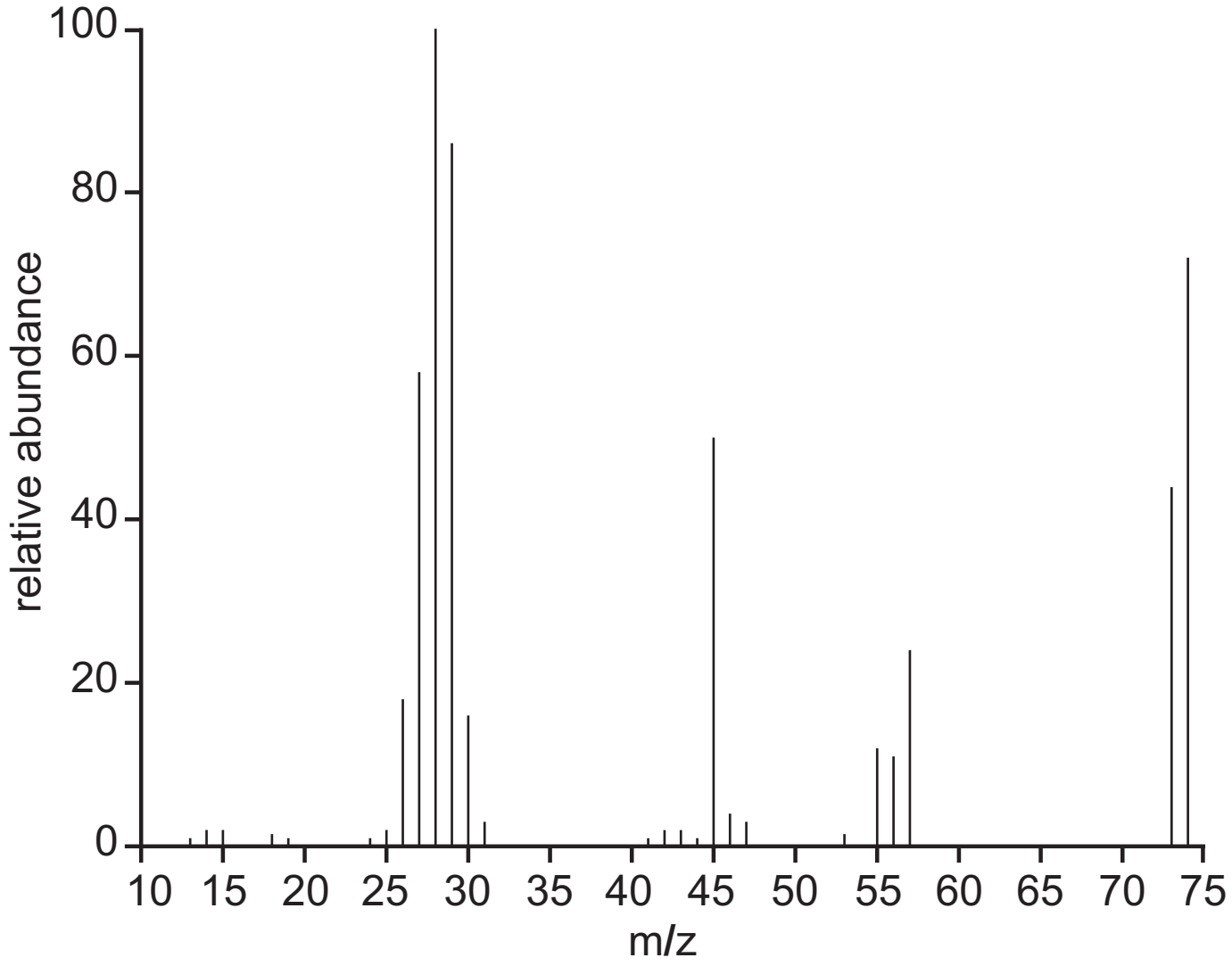
(b) You are provided with an organic liquid containing one functional group, labelled Y. Carry out the following tests and record your observations and deductions in the spaces below. The mass spectrum of Y is also provided.

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

(i) What homologous series does Y belong to? [1]

_____

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



(ii) Draw the structure of Y below. [1]

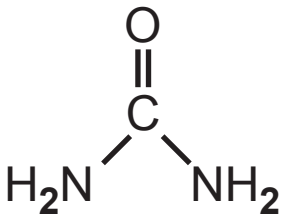
Maximum [25] marks

3 Planning exercise

Preparation of urea

Urea, $(NH_2)_2CO$, 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, $Pb(CNO)_2$, with ammonia and water to produce lead(II) hydroxide and ammonium cyanate, NH_4CNO. The ammonium cyanate then rearranges when heated to form urea, which has a melting point of 133 °C.



urea

(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]

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

$NH_4CNO \rightarrow (NH_2)_2CO$

(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]

(e) How could you use the following infrared spectroscopic data to follow the progress of the rearrangement of ammonium cyanate to urea? [3]

Bond	**Wave number/cm^{-1}**
C = O	1650
C ≡ N	2100
N–H (in amines)	3200–3500

Quality of written communication [2]

THIS IS THE END OF THE QUESTION PAPER

For Examiner's use only		
Question Number	**Marks**	**Moderation Mark**
1		
2		
3		
Total Marks		