Rewarding Learning

Centre Number

Candidate Number

**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**2016**

# Chemistry

## Assessment Unit AS 3
*assessing*
Module 3: Practical Examination

**Practical Booklet B**

**ML**

## [AC134]
## WEDNESDAY 8 JUNE, AFTERNOON

**TIME**

1 hour 15 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.
**You must answer the questions in the spaces provided.**
**Do not write outside the boxed area on each page or on blank pages.**
Complete in blue or black ink only.
Answer **all five** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 66.
**Section A**
Question 1 is worth 15 marks. Question 2 is worth 15 marks.
**Section B**
Question 3 is a planning exercise worth 20 marks.
Questions 4 and 5 are written questions worth a total of 16 marks, testing aspects of experimental chemistry.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Periodic Table of Elements (including some data) is provided.

## Section A

**1** **(a)** A 1.00 g sample of a fertiliser containing ammonium sulfate was heated with 100 $cm^3$ of 0.10 mol $dm^{-3}$ sodium hydroxide which was in excess.

$$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3 + Na_2SO_4 + 2H_2O$$

Heating was continued until all the ammonia had been driven off. The remaining solution was made up to 250 $cm^3$ in a volumetric flask and labelled solution **A**.

25.0 $cm^3$ of solution **A** was then titrated against 0.040 mol $dm^{-3}$ hydrochloric acid and the titre was found to be 23.5 $cm^3$.

**(i)** If all the apparatus is clean and dry write down **two** ways in which the accuracy of the titration can be increased.

_____

_____

_____

_____ [2]

**(ii)** Write down **two** ways in which the reliability of the titration can be increased.

_____

_____

_____

_____ [2]

**(iii)** Write an equation for the reaction of hydrochloric acid with sodium hydroxide.

_____ [1]

**(b)** Use the following steps to calculate the percentage composition by mass of ammonium sulfate in the sample of fertiliser.

**(i)** Calculate the number of moles of hydrochloric acid which reacted with 25.0 $cm^3$ of solution **A**.

**(ii)** Calculate the number of moles of sodium hydroxide in 25.0 $cm^3$ of solution **A**.

**(iii)** Calculate the number of moles of sodium hydroxide in 250 $cm^3$ of solution **A**.

**(iv)** Calculate the number of moles in 100 $cm^3$ of the 0.10 mol $dm^{-3}$ sodium hydroxide solution.

**(v)** Calculate the number of moles of sodium hydroxide which reacted with the ammonium sulfate in the fertiliser.

**(vi)** Calculate the number of moles of ammonium sulfate in the sample of the fertiliser.

**(vii)** Calculate the mass of ammonium sulfate in the sample of the fertiliser.

**[Turn over**

**(viii)** Calculate the percentage by mass of ammonium sulfate in the fertiliser.

[6]

**(c)** Using the equation provided in part **(a)** calculate the volume of ammonia produced at 20 °C and 1 atmosphere pressure, when 2.64 g of ammonium sulfate reacts with excess sodium hydroxide solution.

[4]

**2** **(a)** Compound **Y** is an ionic salt.
The following tests were carried out on **Y** and the observations noted in the table.

**(i)** Complete the table by recording the deductions made from these observations.

| | Test | Observations | Deductions |
|---|---|---|---|
| **1** | Add a spatula measure of **Y** to a test tube one third full of sodium hydroxide solution and warm gently. Carefully smell any gas given off and test it with moist Universal Indicator paper. | Pungent/ choking smell<br><br>Universal Indicator turns blue | [2] |
| **2** | Add a spatula measure of **Y** to a test tube containing 1 $cm^3$ of dilute nitric acid.<br><br>Add 4 drops of barium chloride solution. | No effervescence<br><br>White precipitate forms | [2] |
| **3** | Make a solution of **Y** by dissolving a spatula measure of **Y** in a test tube half-full of water.<br><br>Add 3 drops of sodium hydroxide solution to the test tube. Then add a further 2 $cm^3$ of the sodium hydroxide solution to this test tube. | Brown precipitate<br><br>Precipitate does not dissolve | [1] |

**(ii)** Give the formulae of the **three ions** present in **Y**.

_____ [3]

**[Turn over**

**(b)** Compound **Z** is an organic liquid.
The following tests were carried out on **Z** and the observations noted in the table.

**(i)** Complete the table by recording the deductions made from these observations.

| | Test | Observations | Deductions |
|---|---|---|---|
| **1** | Place 10 drops of **Z** on a watch glass placed on a heatproof mat. Ignite it using a burning splint. | Burns with a non-smoky flame | [1] |
| **2** | Place 1 $cm^3$ of **Z** in a test tube and add 1 $cm^3$ of water. Add a bung and shake the test tube. | One layer forms | [1] |
| **3** | Place 1 $cm^3$ of **Z** in a test tube. Add 2 $cm^3$ of acidified potassium dichromate solution. Warm the mixture gently and leave to stand for 5 minutes. | Orange solution turns green | [1] |
| **4** | Add 4 $cm^3$ of **Z** to half a spatula of iodine in a test tube. Add 4 $cm^3$ of 10% aqueous sodium hydroxide. Shake the test tube vigorously. | Yellow precipitate forms<br><br>Antiseptic smell | [1] |

**(ii)** The organic liquid **Z** has a RMM of **60**. Draw a possible structure for **Z** showing all the bonds present.

[2]

**(iii)** Name compound **Z**.

_____ [1]

**[Turn over**

## Section B

### 3 Planning

Ethanoic acid can be prepared in the laboratory by the following method.

*Place 50 $cm^3$ of water in a round-bottomed flask with some anti-bump granules. Carefully add concentrated sulfuric acid to the flask with swirling and cooling. Add 50 $cm^3$ of potassium dichromate solution. Slowly add a mixture of 15 $cm^3$ of ethanol in 50 $cm^3$ of water, shake the flask and cool if a vigorous reaction occurs. Heat the solution under reflux for twenty minutes. Allow the flask to cool.*

*Rearrange the apparatus and collect the product by distillation.*

**(a) (i)** Write down the purpose of anti-bump granules.

_____ [1]

**(ii)** Suggest why the flask is cooled when concentrated sulfuric acid is added.

_____ [1]

**(iii)** Write down the function of the acidified potassium dichromate solution.

_____ [1]

**(iv)** What does the term **reflux** mean?

_____

_____ [1]

**(v)** Name a suitable drying agent for the distillate. Suggest how it may be removed.

_____

_____ [2]

**(b) (i)** The volume of ethanol used in the procedure was 15 $cm^3$. The density of ethanol is 0.79 g $cm^{-3}$. Calculate the maximum mass of ethanoic acid expected.

[4]

**(ii)** Suggest **two** reasons why the yield is less than 100%.

[2]

**(iii)** Using the table suggest how you could use infrared spectroscopy to show that no ethanol was present in the product from the reaction.

| **bond** | **wave number ($cm^{-1}$)** |
|---|---|
| C—H | 2850–3300 |
| C═O | 1680–1750 |
| O—H (alcohols) | 3230–3350 |
| O—H (acids) | 2250–3000 |

[1]

**[Turn over**

**(c)** Ethanal can also be prepared from the reaction of ethanol with acidified potassium dichromate.

Draw a labelled diagram to show the apparatus which could be used to prepare and collect ethanal from ethanol.

[4]

**(d)** Suggest why the boiling point of ethanal is lower than that of ethanol.

_____

_____

_____ [3]

**4** A student reacted 10.5 g of ethanoic acid with excess ethanol in the presence of concentrated sulfuric acid to produce 5.0 g of ethyl ethanoate (RMM = 88).

**(a)** Write an equation for this reversible reaction.

_____ [2]

**(b) (i)** Explain how the use of excess ethanol increases the yield of ethyl ethanoate.

_____

_____ [1]

**(ii)** Explain how the use of concentrated sulfuric acid increases the yield of ethyl ethanoate.

_____

_____ [1]

**(c) (i)** Calculate the number of moles of ethanoic acid used.

_____

_____ [1]

**(ii)** Calculate the theoretical yield in grams of ethyl ethanoate.

_____

_____ [1]

**(iii)** Calculate the % yield of ethyl ethanoate.

_____

_____ [1]

**[Turn over**

**5** Alums, such as potassium aluminium sulfate, $KAl(SO_4)_2.12H_2O$, are "double salts" which are soluble in water.

**(a)** When heated, potassium aluminium sulfate forms an anhydrous "double salt". How could you ensure that all the water had been removed?

[2]

**(b)** Describe how you could determine the enthalpy change when 5.0 g of potassium aluminium sulfate are dissolved in 100 $cm^3$ of water at room temperature.

[4]

**(c)** Describe a test which would show the presence of aluminium ions in potassium aluminium sulfate solution. Include expected observations.

[3]

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| **Question Number** | **Examiner Mark** | **Remark** |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| **Total Marks** | | |