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

AC134

[AC134]

WEDNESDAY 8 JUNE, AFTERNOON

TIME

1 hour 15 minutes.

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. **Do not write with a gel pen.**
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) Assuming all the apparatus is clean and dry suggest **two** ways in which the accuracy of the titration can be increased.

_____

_____

_____

_____ [2]

(ii) Suggest **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 Universal Indicator turns blue	[2]
2	Add a spatula measure of **Y** to a test tube containing 1 cm^3 of dilute nitric acid. Add 4 drops of barium chloride solution.	No effervescence 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. 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 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 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) State the purpose of anti-bump granules.

_____ [1]

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

_____ [1]

(iii) State the function of the acidified potassium dichromate solution.

_____ [1]

(iv) What is meant by the term **reflux**?

_____

_____ [1]

(v) Name a suitable drying agent for the distillate and 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, including expected observations, which would show the presence of aluminium ions in potassium aluminium sulfate solution.

[3]

THIS IS THE END OF THE QUESTION PAPER

BLANK PAGE

DO NOT WRITE ON THIS PAGE

BLANK PAGE

DO NOT WRITE ON THIS PAGE

DO NOT WRITE ON THIS PAGE

For Examiner's use only		
Question Number	Examiner Mark	Remark
1		
2		
3		
4		
5		
Total Marks		