Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2012

Chemistry

Assessment Unit AS 3

assessing

Module 3: Practical Examination 2

[AC132]

AC132

TUESDAY 22 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 five** questions.
Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.

Section A

Question 1 is a practical exercise worth 25 marks.

Question 2 is a practical exercise worth 29 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 at the end of each question indicate the marks awarded to each question or part question.

A Periodic Table of Elements (including some data) is provided.

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

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(Questions start overleaf)

Section A

1 Titration exercise

The aim of this experiment is to determine the formula of the weak organic acid, RCOOH, by titrating a solution of the acid with sodium hydroxide solution. R is an alkyl group, e.g. C_3H_7.

You are provided with:

A solution of the diluted acid, RCOOH, of concentration $6.0\,g\,dm^{-3}$
A solution of sodium hydroxide of concentration $0.10\,mol\,dm^{-3}$
Phenolphthalein indicator

(a) Describe how you would prepare $250\,cm^3$ of a $6.0\,g\,dm^{-3}$ solution of the organic acid. Calculate the volume of the acid needed if its density is $0.90\,g\,cm^{-3}$. [6]

(b) Carry out the titration as follows:

- Rinse out a burette with 0.10 mol dm^{-3} sodium hydroxide solution.
- Fill the burette with 0.10 mol dm^{-3} sodium hydroxide solution.
- Rinse out the pipette with the organic acid solution.
- Using the pipette and pipette filler, place 25.0 cm^3 of the organic acid solution into the conical flask.
- Add three drops of phenolphthalein indicator to the conical flask and titrate with 0.10 mol dm^{-3} sodium hydroxide solution until the end point is reached.

Present your results in a suitable table on page 6 overleaf and calculate the average titre. [12]

(c) State the colour change at the end point of your titration. [1]

_____

to _____

(d) Write the equation for the reaction of the organic acid, RCOOH, with the sodium hydroxide. [1]

_____

(e) Calculate the molarity of the organic acid solution used in the titration. [2]

_____

_____

_____

_____

(f) **(i)** Calculate the relative molecular mass of the acid. [1]

_____

(ii) Deduce the relative formula mass of the alkyl group, R. [1]

_____

(iii) Write the formula of the acid, RCOOH. [1]

_____

2 Observation/deduction

Safety goggles must be worn at all times and care should be taken during this practical examination.

(a) You are provided with a mixture of two salts labelled **X** containing different cations and different anions. One of the salts is soluble in water and the other is insoluble.

Carry out the tests in the table on pages 10 and 11 overleaf. Record your observations and deductions in the spaces in the table and identify the two salts.

Test	Observations	Deductions
1 Describe the appearance of each salt in the mixture.	[2]	[2]
2 **(a)** Add two spatula measures of **X** to 30 cm^3 of distilled water and stir. Filter.	[2]	
(b) Add five drops of dilute nitric acid to 2 cm^3 of the filtrate.		
(i) Add 1 cm^3 of silver nitrate solution to the acidified filtrate.	[1]	[1]
(ii) In a fume cupboard add 10 cm^3 of concentrated ammonia solution.	[1]	[1]
(c) Dip a clean nichrome wire into concentrated hydrochloric acid and use it to place some of the filtrate into a blue Bunsen flame.	[1]	[1]

3 **(a)** Add three spatula measures of mixture **X** to a boiling tube. Slowly add 4 cm^3 of dilute nitric acid.	[2]	
(b) Test any gas given off with limewater.	[1]	[2]
(c) To the acidified solution of **X** slowly add dilute ammonia solution dropwise. Continue to add dilute ammonia solution until no further change occurs.	[3]	[1]

Name the soluble salt in **X**. [1]

_____

Name the insoluble salt in **X**. [1]

_____

[Turn over

(b) You are provided with a sample of an organic liquid, labelled **Y**. Carry out the following tests. Record your observations and deductions in the spaces provided.

Test	Observations	Deductions
1 Add 5 cm^3 of **Y** to 5 cm^3 of water in a test tube. Stopper the test tube and gently shake the contents. Allow the mixture to settle.	[1]	[1]
2 Add equal amounts of **Y** and potassium dichromate solution to a test tube. Acidify with dilute sulfuric acid and warm the mixture in a water bath.	[2]	[1]
3 Place ten drops of **Y** on a watch-glass placed on a heatproof mat and ignite using a burning splint.	[1]	[1]

What is the functional group present in liquid **Y**? [1]

_____

max [29]

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(Questions continue overleaf)

Section B

3 Planning

The nitrates of the Group II metals are prepared by neutralising dilute nitric acid, HNO_3, with an excess of the corresponding solid hydroxide or carbonate, except for magnesium nitrate which is made from the oxide or the metal.

(a) (i) Write the equation for the reaction of magnesium oxide with nitric acid. [2]

_____

(ii) State how you would know that the reaction was complete. [1]

_____

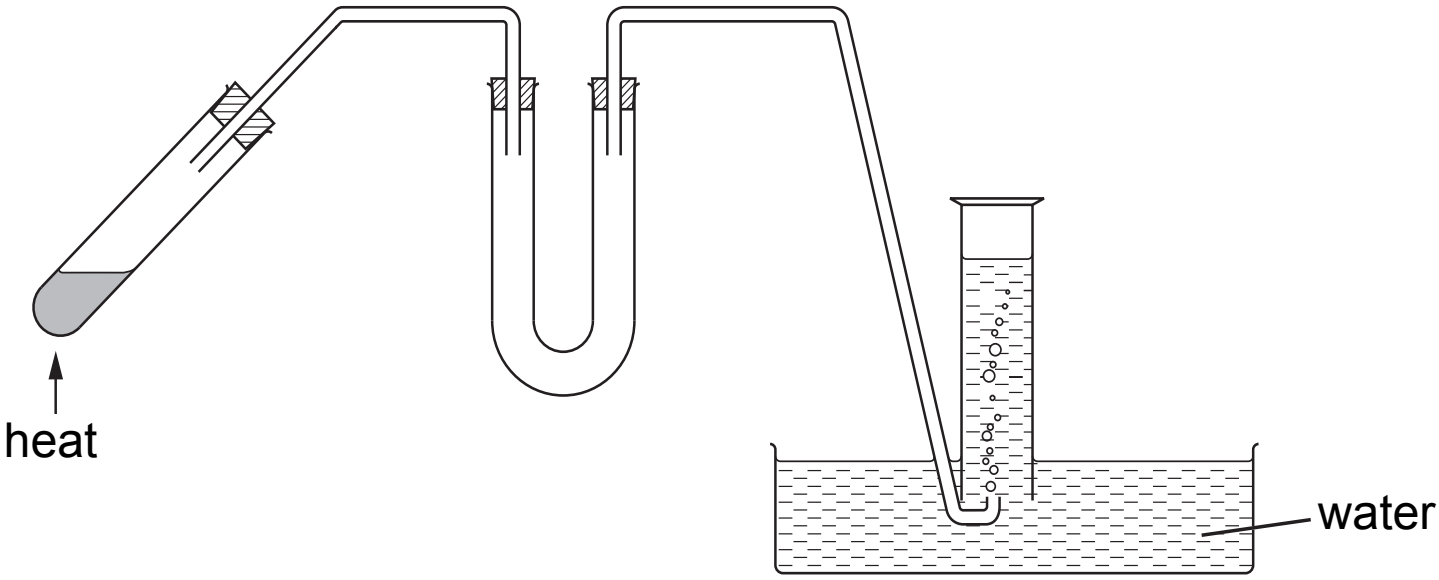
(iii) How would you remove the excess magnesium oxide used? [1]

_____

(b) Group II nitrates decompose when strongly heated according to the following equation:

$$2M(NO_3)_2 \rightarrow 2MO + 4NO_2 + O_2$$

The action of heat on magnesium nitrate may be investigated using the following apparatus.
The nitrogen(IV) oxide is collected in the U-tube.
The oxygen is collected in the gas jar.



(i) Write the equation for the thermal decomposition of magnesium nitrate. [1]

_____

(ii) The boiling point of nitrogen(IV) oxide is 21 °C. How could you ensure that it is collected in the U-tube? [1]

_____

_____

(iii) How would you confirm the presence of oxygen in the gas jar? [2]

_____

_____

_____

(iv) What is the colour of magnesium oxide? [1]

_____

(v) How would you know when the reaction has finished? [1]

_____

(c) Apart from barium nitrate, the Group II nitrates are crystalline solids containing water of crystallisation. Magnesium nitrate crystallises with six molecules of water and both calcium and strontium nitrates with four molecules of water.

(i) What is meant by the term **water of crystallisation**? [1]

_____

_____

(ii) What is the formula for magnesium nitrate crystals? [1]

_____

(iii) How could you remove all the water of crystallisation from magnesium nitrate crystals? [2]

_____

_____

_____

(d) The percentage yield of the reaction in **(b)** can be based on the volume of oxygen produced at 20 °C and 1 atmosphere pressure. Calculate the percentage yield if 150 cm^3 of oxygen are produced from 3.5 g of magnesium nitrate crystals.

moles of oxygen produced [1]

moles of magnesium nitrate crystals used [2]

theoretical moles of oxygen [1]

% yield [2]

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(Questions continue overleaf)

4 Halogenoalkanes may be prepared by the reaction of alcohols with solutions of hydrogen halides.

The following is a method used to prepare bromoethane.

Add 100 cm^3 of concentrated sulfuric acid to a mixture of 60 g of ethanol and 50 cm^3 of water in a distillation flask. Cool and add 100 g of potassium bromide. Distil and collect the bromoethane in a flask surrounded by cold water.

When the reaction is complete wash the bromoethane with water and then separate it from the water. Add anhydrous calcium chloride to the impure bromoethane in a beaker. Filter off the solid and distil the impure bromoethane, collecting the liquid which boils at 35–40 °C. The yield in this preparation is 80%.

(a) (i) Write an equation for the reaction of ethanol with hydrogen bromide. [1]

_____

(ii) Calculate the number of moles of potassium bromide and ethanol used. [2]

_____

_____

_____

(iii) If the yield is 80**%** what mass of bromoethane is obtained? [2]

(b) Explain how you would wash the bromoethane with water and then separate it from water. [4]

(c) What was the purpose of using anhydrous calcium chloride? [1]

5 The densities and the boiling points of haloethanes are listed in the table below.

haloethane	density/g cm^{-3}	boiling point/°C
chloroethane	0.898	12
bromoethane	1.461	38
iodoethane	1.936	72

(a) Suggest why there is an increase in density from bromoethane to iodoethane. [1]

(b) Suggest why there is an increase in boiling point from chloroethane to iodoethane. [2]

(c) All three haloethanes are present in a container at room temperature. Suggest how you would separate and obtain each haloethane. [3]

THIS IS THE END OF THE QUESTION PAPER

Question Number	Marks	
	Teacher Mark	Examiner Check
1		
2		
3		
4		
5		
Total Marks		