Rewarding Learning

Centre Number

71

Candidate Number

ADVANCED
General Certificate of Education
2011

Chemistry

Assessment Unit A2 3
Internal Assessment
Practical Examination 1

[AC231]

AC231

TUESDAY 17 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 **Question 3**.
You may not have access to notes, textbooks and other material to assist you.
A Periodic Table of elements (including some data) is provided.

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

1 Titration exercise

Crystalline ammonium iron(II) sulfate has the formula $Fe(NH_4)_2(SO_4)_2.nH_2O$. The symbol n represents the number of molecules of water of crystallisation.

You are provided with:

A solution of ammonium iron(II) sulfate of concentration $31.4\,g\ dm^{-3}$.

A solution of potassium permanganate of concentration $0.02\,mol\ dm^{-3}$.

Solutions of $2\,mol\ dm^{-3}$ sulfuric acid.

Assuming that all the apparatus is clean and dry, you are required to carry out a titration and use your results to determine the value of n.

(a) Give details of the procedure you intend to use. The potassium permanganate solution should be placed in a burette.

[6]

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

[10]

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

_____ to _____ [2]

(d) Write the equation for the reaction of iron(II) ions (Fe^{2+}) with acidified permanganate ions (H^+/MnO_4^-).

_____ [2]

(e) Calculate the molarity of the ammonium iron(II) sulfate solution.

_____

_____

_____ [2]

(f) Determine the molar mass of the ammonium iron(II) sulfate and deduce the value of n.

_____

_____

_____

_____ [3]

2 Observation/deduction

Safety goggles must be worn at all times and care should be exercised during this investigation.

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

Test	Observation	Deduction
1 Describe the appearance of A.	[1]	[1]
2 Add a spatula measure of A to approximately 50 cm^3 of water and stir.	[2]	[1]
3 Add 10 drops of silver nitrate solution to 2 cm^3 of the solution of A in a test tube. Allow to stand.	[2]	[1]
4 Add 5 drops of sodium hydroxide solution to 2 cm^3 of the solution of A in a test tube.	[1]	[1]
5 In a fume cupboard, add 6 cm^3 of concentrated ammonia, slowly, to 2 cm^3 of the solution of A in a test tube.	[3]	No deduction required
6 Add 4 cm^3 of concentrated hydrochloric acid to 2 cm^3 of the solution of A in a test tube.	[1]	No deduction required

Deduce the name of compound A _____ [1]

Tea… Mar…	Remark

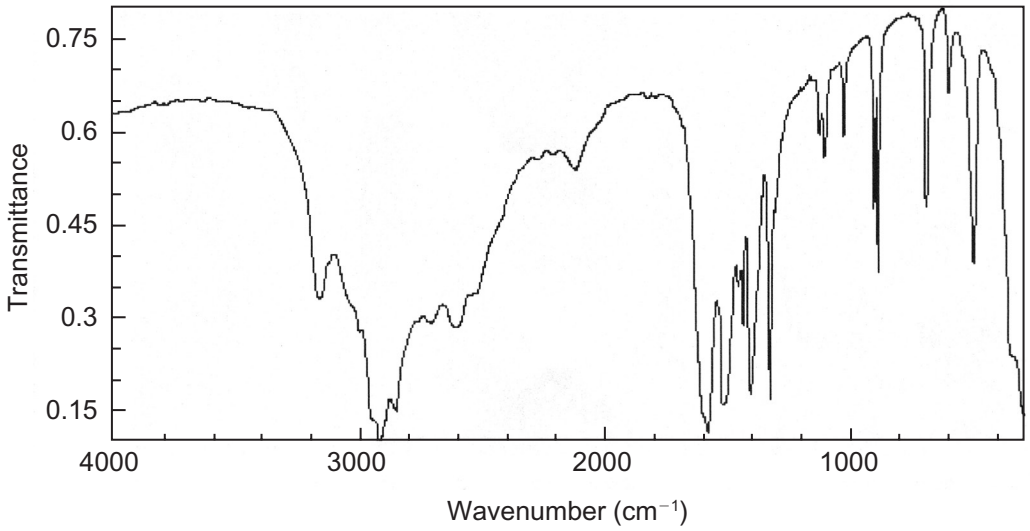
(b) Substance B is an organic compound with two functional groups. Carry out the following tests on B and complete the table.

Test	Observation	Deduction
1 Describe the appearance of B.	[1]	[1]
Below is a description of test 2. Please read this but ***do not carry out this test****.* **2** Heat one spatula measure of B in a test tube. Heat gently at first and then more strongly. Test any fumes with a glass rod dipped in concentrated hydrochloric acid.	White smoke	[1]
3 (i) Dissolve 2 spatula measures of B in approximately 20 cm^3 of water. **(ii)** Use Universal Indicator paper to determine the pH of the solution of B.	[1]	[1]
4 Add 6 drops of copper(II) sulfate solution, dropwise, to a test tube half-full of a solution of B.	[1]	[1]
5 To 3 cm^3 of acidified potassium dichromate solution add one spatula measure of B and warm gently.	[1]	[1]

Tea… Mar…	…emark

The infra-red and n.m.r. spectra of B are shown below. Note that the molecule of B has made an internal structural rearrangement. Use these spectra and the practical tests to suggest the identity of B.

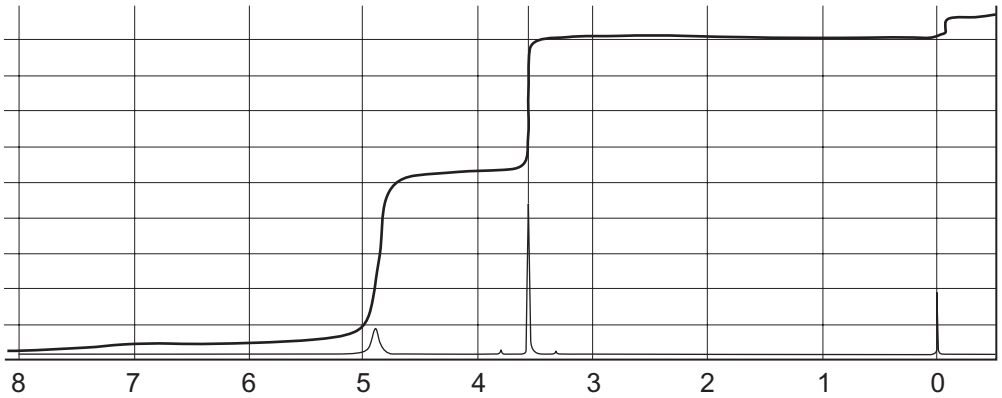
Infra-red Spectrum



Hydrogen atoms attached to electronegative atoms such as N or O absorb in the region above 3000 cm^{-1}. The actual absorption region is affected by acidity and whether the IR spectrum is obtained for the solid or a solution of the substance.

The carbonyl group in ketones absorbs at 1720 cm^{-1}. All other compounds containing C=O groups absorb from 1580 to 1800 cm^{-1}.

N.m.r. spectrum



Identity of B _____ [1]

Maximum [25]

Planning exercise

3 Preparation of sodium peroxide, Na_2O_2.

Sodium peroxide may be prepared by passing dry oxygen over sodium in a "boat" made of aluminium foil which is placed in a combustion tube. The tube is heated until the sodium melts. It is further heated until the sodium burns.

At this stage the heating can be turned down.

After reaction a stream of dry air is passed through the combustion tube. The resulting sodium peroxide is placed in a stoppered bottle and weighed.

The sodium peroxide is obtained as a white solid with a slightly yellow appearance. It reacts readily with water to produce hydrogen peroxide or oxygen depending on the temperature at which the reaction is carried out.

You are required to prepare 1.3 g of sodium peroxide based on the mass of sodium used.

(a) Write an equation, including state symbols, for the reaction of sodium with oxygen to produce sodium peroxide.

_____ [2]

(b) Calculate the mass of sodium needed assuming an 80% yield.

_____

_____

_____

_____

_____ [4]

(c) Explain why it is essential that the oxygen, which is passed over the sodium, is dry.

_____

_____ [2]

Tea... Mar...	Remark

(d) Draw a **labelled** diagram of the apparatus used to prepare sodium peroxide, showing how the oxygen gas may be dried.

[4]

(e) The sodium peroxide may be used to prepare hydrogen peroxide by reacting it with acids at low temperatures. Adding phosphoric(V) acid to sodium peroxide produces disodium hydrogenphosphate, Na_2HPO_4, which crystallises with twelve molecules of water.

(i) Write an equation for the reaction of phosphoric(V) acid with sodium peroxide.

_____ [2]

(ii) Suggest why this method is better than using hydrochloric acid producing sodium chloride, which crystallises without molecules of water, to prepare a *concentrated* solution of hydrogen peroxide.

_____

_____ [2]

(f) Sodium peroxide reacts with water at higher temperatures to form sodium hydroxide and oxygen. Describe how you would use GLC to show that oxygen was given off.

_____

_____

_____ [2]

Quality of written communication [2]

THIS IS THE END OF THE QUESTION PAPER

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