Rewarding Learning

ADVANCED
General Certificate of Education
2011

Chemistry

Assessment Unit A2 3
Internal Assessment
Practical Examination 2

[AC232]

AC232

THURSDAY 19 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		

6621.04**R**

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 $15.7\,g\,dm^{-3}$.

A solution of potassium permanganate of concentration $0.01\,mol\,dm^{-3}$.

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]

Teacher Mark	Examiner Check	Remark

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

Teacher Mark	Examiner Check	Remark

[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]

Teacher Mark	Examiner Check	Remark

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 X. Carry out the following tests.
Record your observations in the spaces below.

Test	Observation	Deduction
1 Describe the appearance of X.	[1]	[1]
2 Add a spatula measure of X to approximately $50\,cm^3$ of water.	[2]	[1]
3 Add 10 drops of silver nitrate solution to $2\,cm^3$ of the solution of X 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 X in a test tube.	[2]	[1]
5 In a fume cupboard, add $6\,cm^3$ of concentrated ammonia, slowly, to $2\,cm^3$ of the solution of X in a test tube.	[2]	No deduction required
6 Add $2\,cm^3$ of edta solution to $2\,cm^3$ of the solution of X in a test tube.	[1]	No deduction required

Deduce the name of compound X _____ [1]

Teacher Mark	Examiner Check	Remark

6621.04**R**   **5**   **[Turn over**

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

Teacher Mark	Examiner Check	Remark

Test	Observation	Deduction
1 Describe the appearance of Y.	[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 Y 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 Y in approximately $20\,cm^3$ of water. **(ii)** Use Universal Indicator paper to determine the pH of the solution of Y.	[1]	[1]
4 Add 6 drops of copper(II) sulfate solution, dropwise, to a test tube half-full of a solution of Y.	[1]	[1]
5 Add $3\,cm^3$ of acidified potassium dichromate(VI) solution. Add one spatula measure of Y and warm gently.	[1]	[1]

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

Teacher Mark	Examiner Check	Remark

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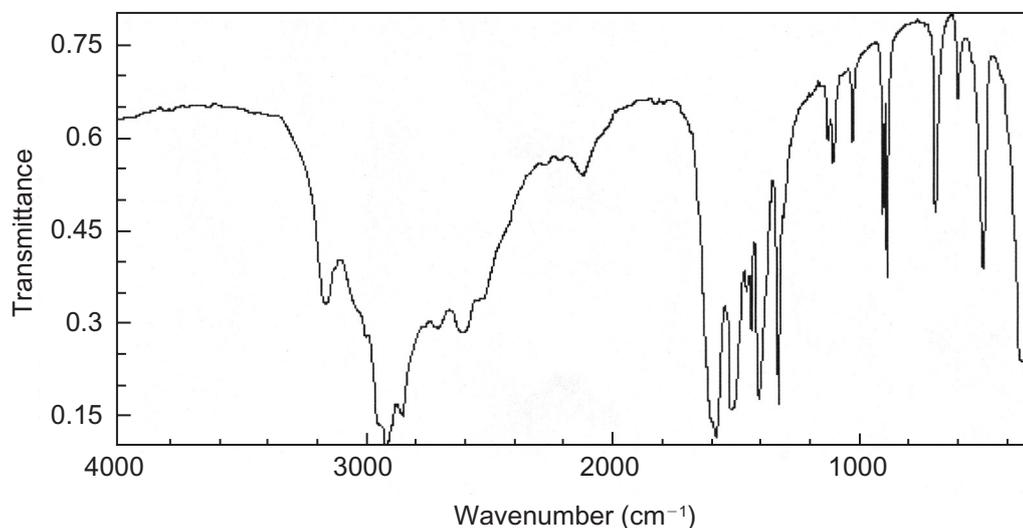
Hydrogen atoms attached to electronegative atoms such as
N or O absorb in the region above $3000\,cm^{-1}$. The actual
absorption region is affected by acidity and whether the
IR spectrum is obtained for the solid or a solution of the
substance.

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
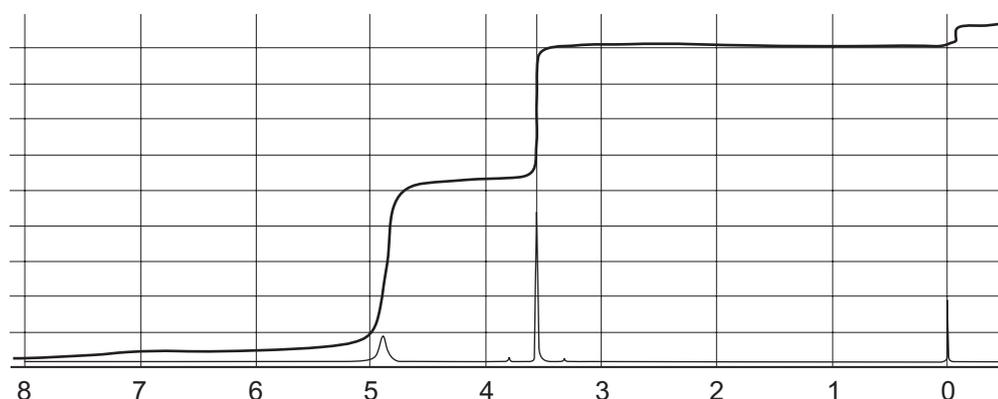
Identity of Y _____ [1]

Maximum [25]

Planning exercise

Teacher Mark	Examiner Check	Remark

3 Preparation of sodium thiosulfate, $Na_2S_2O_3$.

Sodium thiosulfate may be prepared by boiling a mixture of powdered roll sulfur and aqueous sodium sulfate(IV) for 30–40 minutes. Excess sulfur is removed. The resulting solution is concentrated by evaporation.

The evaporated solution, on cooling, produces crystals of sodium thiosulfate pentahydrate which are removed by vacuum filtration.

The crystals are washed with ethanol and dried using filter paper.

The purity of the crystals can be measured by titration with a standard solution of iodine (in potassium iodide solution).

You are required to prepare 2.5 g of sodium thiosulfate pentahydrate crystals.

(a) (i) Write an equation, including state symbols, for the reaction of sodium sulfate(IV) solution with sulfur to produce sodium thiosulfate.

_____ [2]

(ii) Write the formula of sodium thiosulfate pentahydrate.

_____ [1]

(b) Calculate the volume of $0.06 \ mol \ dm^{-3}$ sodium sulfate(IV) needed assuming an 80% yield.

_____

_____

_____

_____

_____ [4]

Teacher Mark	Examiner Check	Remark

(c) Draw a **labelled** diagram of the apparatus used to carry out vacuum filtration.

[4]

(d) Explain the purpose of washing the sodium thiosulfate with ethanol.

[2]

(e) The purity of the sodium thiosulfate may be determined using iodine solution.

(i) Write an equation for the reaction.

[2]

(ii) Calculate the percentage purity of a sample of sodium thiosulfate, if 1.2 g of sodium thiosulfate, $Na_2S_2O_3$, required 25.0 cm^3 of 0.1 mol dm^3 iodine, I_2, solution.

[3]

Quality of written communication [2]

THIS IS THE END OF THE QUESTION PAPER