ST JOSEPH'S INSTITUTION

END-OF-YEAR EXAMINATION 2020
(YEAR 3)

CANDIDATE NAME							
CLASS						INDEX NUMBER	

CHEMISTRY **6092 / 03**

Paper 3 Practical **16 September 2020**
1 hour 15 min

Additional Materials : Nil

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on the cover page of this Question Paper.
Write in dark blue or black ink pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in the spaces provided.

Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner.
The number of marks is given in brackets [ ] at the end of each question or part question.
The use of an approved scientific calculator is expected, where appropriate.

Qualitative Analysis Notes are printed on page 6.

Shift
Laboratory

For Examiner's Use	
Total	**/ 30m**

This document consists of **7** printed pages including this cover page.

[Turn Over

Question 1:

P is a solution containing an impure sample of sodium carbonate. The impurity is a sodium compound. You are to identify the impurity and then determine, by titration with hydrochloric acid, the amount of sodium carbonate present in the impure sample.

P contains 6.00 g of the impure sodium carbonate in 1.00 dm^3.
Q is 0.100 mol/dm^3 hydrochloric acid.

(a) Identification of the impurity in **P**.

Carry out the following tests on solution **P** and record your observations in the table. Test and identify any gas evolved.

test no.	test	observations
1 (a)	To a portion of **P**, add an equal volume of aqueous barium nitrate.	
1 (b)	Add dilute nitric acid to the mixture from 1(a).	
2(a)	To a portion of **P**, add a few drops of aqueous silver nitrate.	
2(b)	Add dilute nitric acid to the mixture from 2(a).	

[8]

The formula of the impurity present in **P** is ……. [1]

(i) Write the ionic equation, with state symbols, for the formation of the compound in 2(a) that leads to the identification of the unknown anion.

…..……...[2]

(b) Determination of the concentration of the sodium carbonate in **P**.

Put **Q** into the burette.

Pipette a 25.0 cm^3 portion of **P** into a flask and titrate with **Q**, using the indicator provided.

Record your results in the table below, repeating the titration as many times as you consider necessary to achieve consistent results.

Results:

Titration number			
Final burette reading / cm^3			
Initial burette reading / cm^3			
Volume of **Q** used / cm^3			
Best titration results (✓)			

[5]

Summary

Tick (✓) the best titration results.

Using these results, the average volume of **Q** required was …….. cm^3.

Volume of solution **P** used was …… cm^3.

[2]

(c) **P** contains 6.00 g of the impure sodium carbonate in 1.00 dm^3.
Q is 0.100 mol/dm^3 hydrochloric acid.

Using your results from **(b)**, calculate the concentration, in mol/dm^3, of the sodium carbonate in **P**.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

concentration of sodium carbonate in **P** …… mol/dm^3. [2]

(d) Using your answer from **(c)**, calculate the mass of sodium carbonate present in 1.00 dm^3 of solution **P**. [the M_r of sodium carbonate is 106]

mass of sodium carbonate present in 1.00 dm^3 of solution **P** is ……g [1]

(e) Using your answer from **(d)**, calculate the percentage by mass of sodium carbonate in the impure sample.

percentage by mass of sodium carbonate in the impure sample is ……..….% [1]

(f) A student performed the above titration experiment. Before he started his titration, he washed the conical flask with solution **P**. He then added 25.0 cm^3 of solution **P** from the pipette. Describe and explain how this would affect the calculated concentration of solution **P** in part **(c)**.

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…..……[3]

[Total : 25]

2 The percentage purity of Na_2CO_3 can be determined by titration as described in **question 1**.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

Based on the equation above, **<u>suggest</u>** another way to determine the percentage purity of sodium carbonate in the impure sample.

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....[5]

NOTES FOR QUALITATIVE ANALYSIS

Test for anions

anion	test	test result
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
lead(II) (Pb^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

[Lead(II) ions can be distinguished from aluminium ions by the insolubility of lead(II) chloride.]

Test for gases

gas	test and test result
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	gives white ppt. with limewater (ppt. dissolves with excess CO_2)
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns aqueous acidified potassium manganate(VII) from purple to colourless

Preparation List (per student)

Preparation List for Question 1:

Apparatus	
Burette (0 – 50.0 cm^3) x 1	Filter Funnel x 1
Pipette (25 cm^3) x 1	Retort stand and clamps x 1
250 cm^3 conical flask x 2	Pipette filler x 1
Distilled water bottle x 1	White Tile x 1
	Methyl orange Indicator x 1

Apparatus	**Quantity (per student)**
Test Tube Rack with 4 test tubes	1
Test tube holder	1
Wooden splints (in goody bag)	2
Delivery tube	1
Bunsen burner	1
Glass rod	1
Chemicals/Materials	**Quantity (per student)**
Common bench reagent rack with: (a) Aqueous sodium hydroxide (1 mol/dm^3) (b) Aqueous ammonia (1 mol/dm^3) (c) Dilute hydrochloric acid (1 mol/dm^3) (d) Dilute sulfuric acid (1 mol/dm^3) (e) Dilute nitric acid (1 mol/dm^3) (f) Limewater (g) Aqueous potassium iodide (0.5 mol/dm^3) (h) Aqueous barium nitrate (0.2 mol/dm^3) (i) Aqueous silver nitrate (0.05 mol/dm^3) (j) Aqueous potassium manganate(VII)	Shared per pair (Placed centrally between two candidates)

Question 2

Chemicals			
[H]	P	150 cm^3	0.1 mol/dm^3 hydrochloric acid
[H]	Q	200 cm^3	6.00g of sodium carbonate in dm^3 and sodium chloride as impurity