Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4230180830

CHEMISTRY **5070/31**

Paper 3 Practical Test **October/November 2021**

1 hour 30 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].
- Notes for use in qualitative analysis are provided in the question paper.

For Examiner's Use	
1	
2	
Total	

This document has **8** pages. Any blank pages are indicated.

[Turn over

1 Hydrated sodium carbonate is sometimes known as washing soda.

An aqueous solution of washing soda, **P**, is made by dissolving 13.73 g of washing soda crystals in water to make 200 cm^3 of solution.

The mass of sodium carbonate, Na_2CO_3, in this aqueous solution of washing soda is determined by titration with dilute nitric acid, $HNO_3(aq)$.

$$Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + CO_2 + H_2O$$

Methyl orange is used to determine the end-point of the titration.

Q is 0.400 mol / dm^3 $HNO_3(aq)$.

(a) Fill the burette with **Q**.

Pipette 25.0 cm^3 of **P** into a flask and titrate with **Q** using three drops of methyl orange as the indicator.

The end-point is the first appearance of a pink colour that remains for 30 seconds.

Record your results in the table.

Repeat the titration as many times as necessary to achieve consistent results.

Results

titration number	1	2	
final burette reading / cm^3			
initial burette reading / cm^3			
volume of **Q** used / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Use the best titration results to calculate the average volume of **Q** used.

..... cm^3
[12]

(b) **Q** is 0.400 mol / dm^3 HNO_3(aq).

Use your results from **(a)** to calculate the number of moles of HNO_3 in the average volume of **Q** used.

Give your answer to **three** significant figures.

..... mol [1]

(c) Use your answer from **(b)** to calculate the number of moles of Na_2CO_3 in 25.0 cm^3 of **P**.

$$Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + CO_2 + H_2O$$

..... mol [1]

(d) Use your answer from **(c)** to calculate the number of moles of Na_2CO_3 in 200 cm^3 of **P**.

..... mol [1]

(e) Use your answer from **(d)** to calculate the mass of Na_2CO_3 in 200 cm^3 of **P**.

[A_r: C,12; O,16; Na, 23]

..... g [2]

The aqueous solution of washing soda, **P**, is made by dissolving 13.73 g of washing soda crystals in water to make 200 cm^3 of solution.

Washing soda crystals contain water of crystallisation.

The formula is $Na_2CO_3 \cdot \mathbf{x}H_2O$

(f) Use your answer from **(e)** to calculate the mass of water, H_2O, in 13.73 g of washing soda crystals.

..... g [1]

(g) Use your answer from **(f)** to calculate the number of moles of water, H_2O, in 13.73 g of washing soda crystals.

[M_r: H_2O,18]

..... mol [1]

(h) Use your answers from **(d)** and **(g)** to calculate the value of **x**.

Give your answer to the nearest whole number.

Show your working.

x = ... [1]

[Total: 20]

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2 You are provided with solutions **R**, **S** and **T**.

(a) (i) Do the tests on **R** and **S** shown in the table.

Record your observations in the table.

Test and name any gases produced.

Describe the test and the positive result for any gases you name.

test no.	test	observations
1	To 1 cm depth of **R** in a boiling tube, add a small amount of manganese(IV) oxide.	
2	To 1 cm depth of **S** in a test-tube, add 1 cm depth of dilute nitric acid. Add **R** drop-by-drop until a change is seen.	
3	To 1 cm depth of **S** in a test-tube, add aqueous sodium hydroxide drop-by-drop until a change is seen. Add excess aqueous sodium hydroxide.	
4	To 1 cm depth of **S** in a test-tube, add three drops of dilute nitric acid and then add 1 cm depth of aqueous silver nitrate.	

[9]

Conclusions

(ii) Name the cation in **S**.

cation ..... [1]

(iii) Name the anion in **S**.

anion ..... [1]

(b) (i) Do the tests on **T** shown in the table.

Record your observations in the table.

Do **not** test any gases produced.

test no.	test	observations
1	To 1 cm depth of **T** in a test-tube, add a small amount of magnesium turnings. Wait until no further change is seen.	
2	To 1 cm depth of **T** in a test-tube, add aqueous sodium hydroxide drop-by-drop until a change is seen. Continue to add aqueous sodium hydroxide drop-by-drop until it is in excess.	
3	To 1 cm depth of **T** in a test-tube, add aqueous ammonia drop-by-drop until a change is seen. Continue to add aqueous ammonia drop-by-drop until it is in excess.	

[8]

Conclusions

(ii) Name the cation in **T**.

cation ..... [1]

[Total: 20]

QUALITATIVE ANALYSIS NOTES

Tests 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 add aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt., insoluble in excess dilute nitric acid

Tests 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.
chromium(III) (Cr^{3+})	green ppt., soluble in excess giving a green solution	green ppt., insoluble in excess
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
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Tests for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	‘pops’ with a lighted splint
oxygen (O_2)	relights a glowing splint