Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

7266146103

CHEMISTRY **5070/31**

Paper 3 Practical Test **October/November 2020**

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. Blank pages are indicated.

1 Citric acid is a carboxylic acid found in lemon juice.

The equation for the reaction between citric acid, $H_3C_6H_5O_7$, and potassium hydroxide, KOH, is shown.

$$3KOH + H_3C_6H_5O_7 \rightarrow K_3C_6H_5O_7 + 3H_2O$$

The mass of citric acid dissolved in 500 cm^3 of an aqueous solution can be determined by titration with KOH(aq).

Thymolphthalein is used to determine the end-point of the titration.

P is 0.100 mol / dm^3 KOH(aq).

Q is aqueous citric acid.

(a) Put **P** into the burette.

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

The end-point is the first appearance of a blue 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

Burette readings

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

Summary

Tick (✓) the best titration results in the table.

Using the best titration results the average volume of **P** required is .... cm^3.
[12]

(b) **P** is 0.100 mol / dm^3 KOH(aq).

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

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

number of moles of KOH .... [1]

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

$$3KOH + H_3C_6H_5O_7 \rightarrow K_3C_6H_5O_7 + 3H_2O$$

number of moles of citric acid in 25 cm^3 of **Q** .... [1]

(d) Use your answer from **(c)** to calculate:

(i) the concentration of citric acid in **Q**.

concentration of citric acid in **Q** .... mol / dm^3 [1]

(ii) the number of moles of citric acid in 500 cm^3 of **Q**.

number of moles of citric acid in 500 cm^3 of **Q** .... [1]

(e) Citric acid is available in hydrated form.

The formula of hydrated citric acid is $H_3C_6H_5O_7.H_2O$

Use your answer from **(d)(ii)** to calculate the mass of hydrated citric acid crystals needed to make 500 cm^3 of **Q**.

[A_r: H, 1; C,12; O,16]

mass of hydrated citric acid in 500 cm^3 of **Q** .... g [2]

[Total: 18]

2 You are provided with solution **R** and solid **S**.

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

Record your observations in the table.

You should test and name any gases evolved.

test no.	test	observations
1	To 1 cm depth of **R** in a test-tube, add a few drops of universal indicator solution. Keep the solution for use in test **2**.	
2	To the solution from test **1**, add dilute nitric acid drop by drop until a change is seen.	
3	To 1 cm depth of **R** in a boiling tube, add 1 cm depth of aqueous sodium hydroxide. Gently warm the mixture. Keep the solution for use in test **4**.	
4	To the solution from test **3**, add 3 cm depth of dilute nitric acid and then add 1 cm depth of aqueous silver nitrate.	

[6]

(ii) Identify the cation responsible for the colour seen in test **1**.

cation .... [1]

(iii) Identify the cation responsible for the observations in test **3**.

cation .... [1]

(iv) Identify the anion responsible for the observation in test **4**.

anion .... [1]

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

Record your observations in the table.

You should test and name any gases evolved.

test no.	test	observations
1	To the sample of **S** in a boiling tube, add 2 cm depth of dilute nitric acid. Keep the solution for use in tests **2**, **3** and **4**.	
2	To 1 cm depth of the solution from test **1** in a test-tube, add aqueous sodium hydroxide drop by drop until a change is seen. Add excess aqueous sodium hydroxide.	
3	To 1 cm depth of the solution from test **1** in a test-tube, add aqueous ammonia drop by drop until a change is seen. Add excess aqueous ammonia.	
4	To 1 cm depth of the solution from test **1** in a test-tube, add a few drops of dilute nitric acid and then add 1 cm depth of aqueous barium nitrate.	

[11]

(ii) Identify solid **S**.

solid **S** .... [2]

[Total: 22]

BLANK PAGE

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