Candidate Name	:
Index No.	:

Anglo-Chinese School (Independent)

Year 4 Express
Preliminary Examination 2023

CHEMISTRY
PAPER 3 Practical

6092/3

Thursday **31 July 2023** 1 hour 50 minutes

Candidates are to write their answers on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Candidate number in the space at the top of this page and on any separate answer paper used.
Write in dark blue or black pen on both sides of the paper.
You may use a 2B pencil for any diagrams or graphs.
Do not use paper clips, glue or correction fluid.

Answer **all** questions in all the spaces provided.
The use of an approved scientific calculator is expected, where appropriate.
You should show the essential steps in any calculation and record experimental results.
Qualitative analysis notes are printed on page 10.

Shift
Laboratory

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
Total	**/40**

This question paper consists of 10 printed pages.

1 Acids of general formula HYO_3 are known, where Y can be nitrogen, phosphorus, chlorine or bromine.

P is a solution of one of these acids containing 3.75 g in 500 cm^3.

Q is 0.100 mol/dm^3 sodium hydroxide.

You are to identify Y by titrating **Q** with **P**.

a Put solution **P** into the burette.

Pipette a 25.0 cm^3 (or 20.0 cm^3) portion of **Q** into a flask and titrate with **P** using the indicator provided.

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

Results [5]

b From your titration results, obtain an average volume of **P** to be used in your calculations. Show clearly how you obtained this volume. [1]

Average volume of **P** .....

c **Q** is 0.100 mol/dm^3 sodium hydroxide.
One mole of the acid HYO_3 reacts with one mole of sodium hydroxide. Using the titration results, calculate the concentration, in mol/dm^3 of the acid HYO_3 present in solution **P**. [2]

Concentration of HYO_3 in **P** = ...

d **P** is aqueous HYO_3 which contains 3.75 g in 500 cm^3.
Using your answer to **(c)**, calculate the relative molecular mass of HYO_3. [2]

Relative molecular mass of HYO_3 = ...

e Complete the table below. The relative atomic masses of hydrogen and oxygen are 1 and 16 respectively. [1]

Element	**Relative atomic mass**	**Formula of its acid HYO_3**	**Relative molecular mass of its acid**
Bromine (Br)	80	$HBrO_3$	
Chlorine (Cl)	35.5	$HClO_3$	
Nitrogen (N)	14	HNO_3	
Phosphorus (P)	31	HPO_3	

f Using your answer to **(d)** and the information in the completed table to identify the element Y. [1]

Y is = ...

[Total : 12]

2 A metal ore, **X** in the form of an oxide contains **an impurity**. Carry out the following experiments on the impure solid **X**. Record your observations in the table. You should test and name any gas evolved.

Tests on impure solid **X**

Test No.	Test		Observations
a	Place **HALF** of the solid **X** sample in a test tube and add half a test tube of distilled water. Stir and filter the mixture:		
b	Carry the following tests on the filtrate.		
	(i)	To a portion of the filtrate from **test (a)**, add aqueous sodium hydroxide and warm.	
	(ii)	To a portion of the filtrate from **test (a)**, add a few drops aqueous silver nitrate until a change is seen. Then, add aqueous ammonia until a change is seen.	
c	Place the remaining **HALF** of the solid **X** sample in a test tube and add half a test tube of dilute nitric acid. Stir and filter the mixture: Keep the filtrate for tests **c(i)** and **c(iii)**.		
	(i)	To a portion of the solution in **(c)**, add aqueous ammonia until there is no further change.	

	(ii)	To a portion of the solution in **(c)**, add aqueous potassium iodide and leave it to stand. Filter the mixture to better assess it.	
	(iii)	To a portion of the solution in **(c)**, *(1)* add equal volume of aqueous sodium hydroxide and *(2)* warm the mixture.	

[11]

d Name the metal in the ore **X** and the impurity it contains. [2]

.....

e **(i)** The ionic equation for the reaction in test **c(iii)***(1)*. [1]

.....

(ii) The chemical equation for the reaction in test **c(iii)***(2)*. [1]

.....

f Based on the observation in test **c(ii)**, explain why a redox reaction has taken place. [2]

.....

.....

.....

g Suggest why dilute nitric acid is used instead of sulfuric acid or hydrochloric acid for the purpose in test **(c),** as a precautionary measure. [1]

.....

.....

.....

i Hydrogen peroxide decomposes according to the equation shown below:

$$2\ H_2O_2\ (aq) \rightarrow 2\ H_2O\ (l) + O_2\ (g)$$

Solid **X** and manganese(IV) oxide are suitable catalysts for the decomposition reaction. Outline an experiment by which you can determine whether solid **X** or manganese(IV) oxide is a better catalyst.

You can assume all the apparatus and regents normally found in a school laboratory are available.

In your method, you should state the variables and assumptions where appropriate. You should also include a diagram and the measurements you would take and explain how you arrive at the conclusion. [4]

[Turn over

[Total : 22]

3 A student investigated how concentration of dilute sulfuric acid affects the rate of reaction with magnesium ribbon.

He carried out the following experiments by adding magnesium to excess dilute sulfuric acids of varying concentrations. His procedure was as follows:

a **i** Using a measuring cylinder, transfer 30 cm^3 of 1.0 mol/dm^3 dilute sulfuric acid into a beaker.

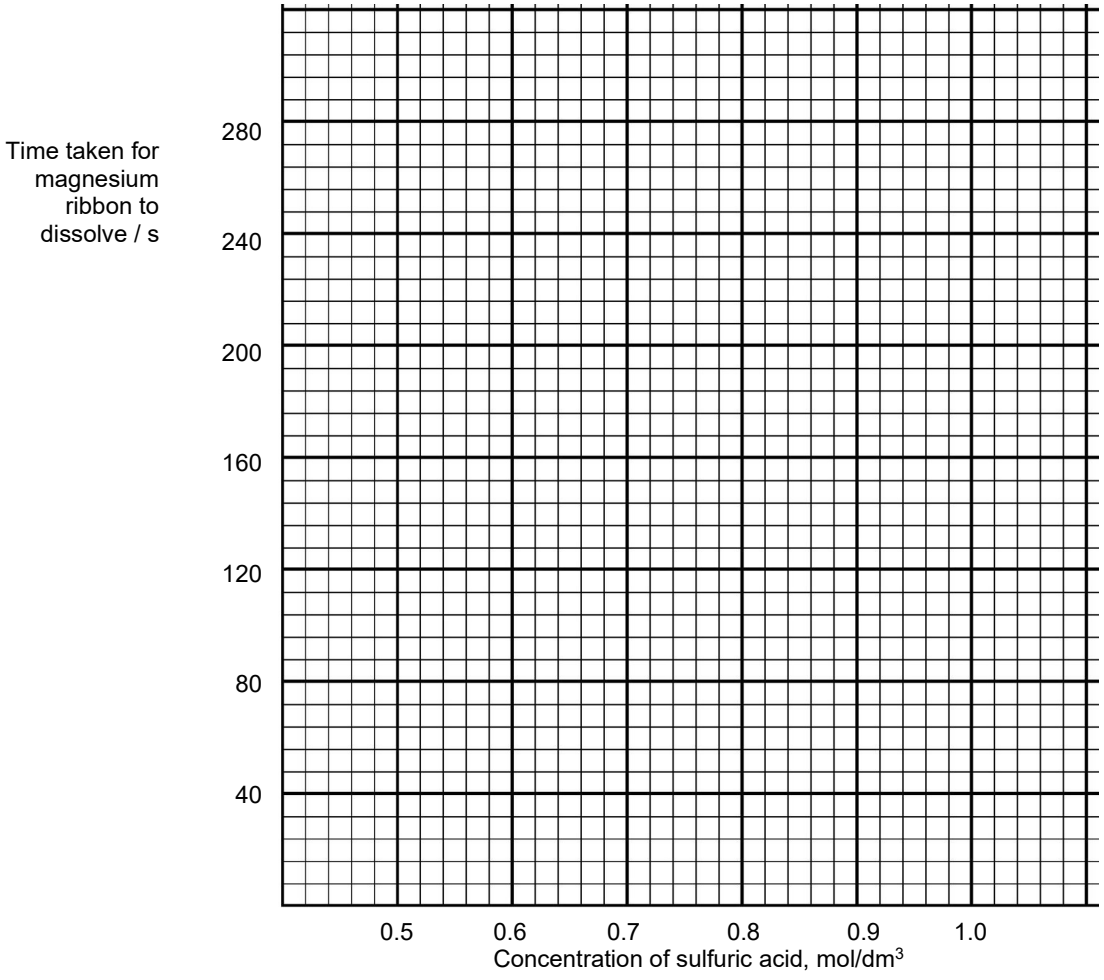
ii Add a piece of magnesium ribbon 4 cm in length to the acid and start the stopwatch at the same time. Measure the time taken for the magnesium to dissolve and record the time taken to the nearest second.

iii Wash the beaker and rinse with distilled water.

iv Repeat steps **(i)** to **(iii)** using 0.8, 0.6 and 0.5 mol/dm^3 dilute sulfuric acid instead of 1.0 mol/dm^3.

Experiment	Concentration of sulfuric acid / mol/dm^3	Time taken for magnesium ribbon to dissolve / s
1	1.0	105
2	0.8	112
3	0.6	139
4	0.5	265

b Use the data in the table to plot the graph using the axes provided. [1]



c Describe the trend shown in the graph and give a conclusion for the results.

[1]

.....

.....

d Another experiment using 30 cm^3 solution of 0.0210 mol sulfuric acid was carried out according to the procedure above. Using the graph in **(b)**, predict the time taken for the 4 cm length magnesium to dissolve. [2]

e Suggest two changes that could be made to improve the experiments and obtain more accurate readings. [2]

Suggestion 1 : .....

.....

Suggestion 2 : .....

.....

[Total : 6]

QUALITATIVE ANALYSIS NOTES

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-}) [in solution]	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^-)	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.

Tests 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.]

Tests for gases

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