Centre Number	Candidate Number

Candidate Name _____

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for General Certificate of Education Ordinary Level

Chemistry 5070/3

Paper 3

Tuesday **18 JULY 2017**

Additional Information:
Mathematical tables/Calculators (non-programmable)

Time 1 hour 30 minutes

Instructions to Candidates

Write your **name, centre number and candidate number** in the spaces at the top of this page.

There are **two (2) questions** in this paper. Answer **both** questions.

You should show the essential steps in any calculation and record all experimental results and observations in the spaces provided on the question paper.

If you are using semi-micro methods in Question **2**, you should modify the instructions to suit the size of apparatus and the techniques you are using.

Information for Candidates

The number of marks is shown in brackets [ ] at the end of each question or part question.

Each question carries 50% of the total marks.

Mathematical tables and Non-programmable calculators can be used.

Qualitative Analysis notes for this paper are printed on page 6.

Periodic Table is printed on page 7.

Cell phones are not allowed in the examination room.

FOR EXAMINER'S USE	
1	
2	
TOTAL	

This question paper consists of 6 printed pages

1 Volumetric Analysis (titration)

P is a solution of dibasic acid, H_2X, suspected to be either carbonic acid, H_2CO_3 or sulphuric acid, H_2SO_4.

Q is a 0.1000 mol/dm^3 NaOH.

You are to determine the concentration of H_2X in **P** by titration and use it to identify H_2X.

P contains **3.44g/dm^3** H_2X

(a) Put **P** into the burette. Pipette a 25.0cm^3 (or 20.0cm^3) portion of **Q** into a conical flask. Add 3 drops of the indicator provided and then titrate with **P**. Record your results in the table, repeating the titration procedure as many times as you consider necessary to achieve consistent results.

Tick (✓) the consistent (concording) results as your best results.

Indicate the average of the ticked values in the summary.

The results i.e. burette readings/cm^3.

Titration Number	1	2	
Final reading			
Initial reading			
Volume of **P** used			
Best titration results (✓)			

Summary: The volume of **Q** used is _____ cm^3

The average volume of **P** required was _____ cm^3

[12]

(b) **Q** is 0.1000 mol/dm^3 sodium hydroxide. Using your results from **(a)** calculate the concentration, in mol/dm^3, of H_2X in **P**.

Concentration of H_2X in **P** = _____ mol/dm^3 [3]

(c) **P** contains **3.44g** of H_2X per dm^3. Use your answer to **(b)** to calculate the molar mass of H_2X.

Molar mass of H_2X = _____ g/mol [2]

(d) Calculate the relative formula masses (RFM) of both H_2CO_3 and H_2SO_4

(i) H_2CO_3 **(ii)** H_2SO_4

RFM= _____ RFM= _____ [2]

(e) Hence identify H_2X.

H_2X is _____ [1]

Total 20 marks

2 Qualitative Analysis (Salt analysis)

You are provided with solutions **R** and **S**. **R** and **S** contain one salt each with one cation and one anion both specified in the 5070/3 syllabus.

Carry out the following tests on **R** and **S** and record your results in the table below accordingly.

You should identify and name any gases evolved.

Test No.	Test on R	Observation
1	To a portion of **R**, add an equal volume of aqueous silver nitrate solution (KEEP FOR TEST 2)	
2 (a)	Divide the mixture in **(a)** above into two. To one portion, add dilute nitric acid and	
(b)	to the other portion add an equal volume of aqueous ammonia.	
3 (a)	To a portion of **R**, add aqueous sodium hydroxide little by little until in excess.	
(b)	Allow the mixture in **(a)** to stand for sometime	
4 (a)	To a portion of **S**, add aqueous sodium hydroxide until a change is seen.	
(b)	Add excess aqueous sodium hydroxide to the mixture in **(a).** (Keep the resultant for test C)	
(c)	Put half of the resultant from test **(b)** into a test tube, add aluminium foil and then warm carefully.	
5 (a)	To a portion of **S,** add aqueous ammonia until a change is seen.	
(b)	To a mixture in **(a)** above add excess aqueous ammonia.	

[17]

Conclusion

(i) The formula of the cation in solution **R** is ..... [1]

(ii) What process has the cation in **R** undergone in test **3 (b)**?

..... [1]

(iii) The formula of the salt in solution **S** is _____ [1]

Total 40 marks

NOTES FOR USE IN 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 lead (II) nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulphate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations [in solutions]

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. or very slight white 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
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Test 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
sulphur dioxide (SO_2)	turns aqueous potassium dichromate(VI) green

DATA SHEET
The Periodic Table of the Elements

Group I	Group II						Group III	Group IV	Group V	Group VI	Group VII	Group 0
						1 H Hydrogen 1						4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4						11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12						27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	98 Tc Tchnetium 43	104 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mecury 80	204 Tl Thallium 81	207 Pb lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 +															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
+90-103 Actinoid series

Key: a / X / b — a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

$N_A = 6.0 \times 10^{23}$/mol; 1F = 96500C.

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