NAME:…… index No……

Signature …… School ……

P525/1
CHEMISTRY
Paper 1
July/Aug 2023
$2\frac{3}{4}$ hours

BUGANDA EXAMINATION COUNCIL MOCKS 2023

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY PAPER 1

2 HOURS 45 MINUTES

INSTRUCTIONS TO CANDIDATES:

- *Answer **ALL** questions in Section **A** and **SIX** questions in Section **B**.*
- *All questions must be answered in the spaces provided.*
- *The Periodic Table, with relative atomic masses, is supplied at the end of the paper.*
- *Mathematical tables (3-figure tables) and adequate or non-programmable scientific electronic calculators may be used*
- *Illustrate your answers with equations where applicable.*
- *Molar gas constant, R = 8.31 $JK^{-1}mol^{1}$*
- *Molar Volume of gas at s.t.p is 22.4 litres.*
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For Examiner's Use Only																	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	

SECTION A (46 MARKS)

Answer **all** questions in this section.

1. The standard electrode potentials for some redox systems are shown below.

$PbO_{2(s)} + 4H^+_{(aq)} + 2e \rightarrow Pb^{2+}_{(aq)} + 2H_2O_{(l)}$ $\quad E^0 = +1.46V$

$O_{2(g)} + 4H^+_{(aq)} + 4e \rightarrow 2H_2O_{(l)}$ $\quad E^0 = +1.23V$

(a) Write:

(i) the notation for the cell formed when the half cells are combined. (01 mark)

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(ii) the overall equation for the reaction. (1½ marks)

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(b) (i) Calculate the e.m.f of the cell in (a). (01 mark)

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(ii) State whether the cell reaction is feasible or not. Give a reason for your answer. (01 mark)

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2. Complete the following equations and in each case name the main organic product.

(a) $(CH_3)_2CH_2Br \xrightarrow[Dry\ ether]{Na}$ …… *(1½ marks)*

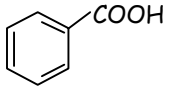
Name of product……

(b) $CH_3CH{=}CH_2 + HBr(g) \xrightarrow{CH_3OOCH_3}$ …… *(1½ marks)*

Name of product……

(c) $CH_3CHO \xrightarrow{H_2N-NH_2/H^+}$…… *(1½ marks)*

Name of product……

(d) CH_3CH_2OH +  $\xrightarrow[heat]{H^+}$ ..... *(1½ marks)*

Name of product.....

3. (a) State

(i) What is meant by the term **complex ion**? *(01 mark)*

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(ii) **three** factors that can favour formation of complexes. *(1½ marks)*

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(b) Complete the table below by providing the name of each of following complexes. *(02 marks)*

Complex	**Name of complex**
$[Fe(CN)_6]^{3-}$	
$[Cu(NH_3)_4(H_2O)_2]^{2+}$	

(c) A concentrated solution of sodium carbonate was added to a solution of iron (III) chloride.

(i) State what was observed. (01 mark)

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(ii) Write equation for the reaction that took place. *(01 mark)*

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4. (a)(i) Briefly describe how a sample of soap can be prepared. (2½ marks)

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(ii) Write equation leading to the formation of soap. (01 mark)

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(b) (i) Explain why soap cannot be effectively used in strongly acidified medium. (1½ marks)

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(ii) State **one** advantage of soap as compared to soapless detergents. (0½ marks)

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5. (a) Beryllium like aluminium can react with aqueous sodium hydroxide whereas other group (II) elements in the Periodic Table do not.

(i) List **three** other properties in which beryllium shows similarity to aluminium. (02 marks)

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(ii) State **two** reasons why beryllium behaves differently from other group (II) elements. (01 mark)

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(b) Write equation for the reaction between aqueous sodium hydroxide and

(i) beryllium. (1½ marks)

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(ii) aluminium. (1½ marks)

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6. 30cm^3 of a gaseous hydrocarbon **Q** (C_xH_y) was exploded with 200cm^3 of oxygen which was in excess. On cooling to room temperature, the residual gases occupied 155 cm^3. When the residual gases were passed through potassium hydroxide, the volume decreased by 120 cm^3.

(a) Calculate the molecular formula of **Q**. *(03 marks)*

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(b) **Q** forms a red precipitate on treatment with a solution of copper (I) chloride in aqueous ammonia. Write

(i) the structural formula and IUPAC name of **Q**. *(01 mark)*

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(ii) equation for the reaction between **Q** and solution of copper(I) chloride in aqueous ammonia. *(01 mark)*

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7. Phosphorus(V) chloride decomposes at high temperatures according to the following equation.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g);$$

(a) Write an expression for the equilibrium constant, K_c. (0$\frac{1}{2}$ mark)

(b) When 1 mole of phosphorus(V) chloride was placed in a 1 litre vessel and heated at 350°C and at a certain pressure, the equilibrium mixture was found to contain 38.4% of chlorine.

(i) Calculate the equilibrium constant, K_c. (03 marks)

(ii) The equilibrium constant for the above reaction at 250°C was found to be 1.54. State whether the reaction is exothermic or endothermic. Give a reason for your answer. (01 mark)

(c) State what would happen to the concentration of chlorine if the pressure in the vessel was decreased while temperature is maintained at $350^{\circ}C$. Give a reason for your answer. (1½ marks)

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8. Name **one** reagent that can be used to distinguish between the following pairs of compounds. In each case, state what would be observed if each member of the pairs is separately treated with the reagent you have named.

(a) C_6H_5CHO and CH_3CH_2CHO (03 marks)

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(b) $(CH_3)_2CHNH_2$ and $(CH_3)_2NH$ (03 marks)

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9. (a) The thermo chemical data for some processes are shown below:

Process	**Energy** $(\mathbf{kJmol^{-1}})$
Atomisation of calcium	$+178$
First ionisation energy of calcium	$+590$
Second ionisation energy of calcium	$+1146$
Formation of calcium fluoride	-1220
Lattice energy of calcium fluoride	$+2720.7$
Bond dissociation of fluorine	$+242.7$

(a) Calculate the first electron affinity of fluorine. *(02 marks)*

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(b) Determine the enthalpy of solution of calcium fluoride crystal (Enthalpies of Ca^{2+} and F^- ions are -1587 and $-515 kJmol^{-1}$) (02 *marks*)

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(c) (i) State the effect of temperature on the solubility of calcium flouride (0½ mark)

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(ii) Give a reason for your answer in b(i) (0½ *mark)*

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SECTION B (54 MARKS)

Answer **six** questions from this section.

10. State what would be observed and write equation for the reaction that would take place when:

(a) Solid sodium iodide is heated with concentrated sulphuric acid. (02 marks)

Observation

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Equation

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(b) propanal is boiled with Fehling's solution. (02 marks)

Observation

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Equation

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(c) Sodium nitrite was added to acidified potassium dichromate(VI) solution. (2½ marks)

Observation

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Equation

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(d) Chlorine water is added to aqueous solution of iron(II) sulphate. (2½ marks)

Observation

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Equation

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(e) cold alkaline potassium manganate(VII) is added cyclohexene. (02 marks)

Observation

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Equation

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11. Carbon, silicon, germanium and tin are some of the elements of group IV of the Periodic Table.

(a) Write the general outermost electronic configuration of the elements. (0½ mark)

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(b) State the trend in the metallic nature and explain your answer. (1½ marks)

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(b) State **two**

(i) reasons why carbon shows differences in its properties from the rest of the elements in the same group. (01 mark)

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(ii) properties in which carbon differs from the other elements. (02 marks)

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(d) (i) Write the formulae of hydride of each of the elements. (02 marks)

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(ii) Describe how each of the hydrides in (d)(i) react with water. (02 marks)

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12. Write equations to show how the following conversions can be carried out.

(a) Cyclohexanol from benzene and propene. (03 marks)

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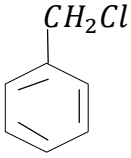
(b) $HC \equiv CH$ to 

(03 marks)

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(c) Ethanol to 2-hydroxypropanoic acid. (03 marks)

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13. (a) Write the electronic configuration of manganese. (01 mark)

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(b) Potassium manganate(VII) is commonly employed in volumetric analysis. However, it solution must be first standardized.

(i) State **two** advantages of using potassium manganate(IV) in volumetric analysis. (02 marks)

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(ii) Name **one** substance that can be used to standardized potassium manganate(VII). (01 mark)

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(c) State what would be observed and write equation for the reaction that would take place when to acidified potassium manganate(VII) is added:

(i) potassium iodide solution. (2½ marks)

Observation

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Equation(s)

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(ii) ethane-1,2-dioic acid and mixture heated. (2½ marks)

Observation

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Equation

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14. (a)Define the term **common ion effect**. (01 mark)

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(b) Zinc hydroxide is sparingly soluble in water.

Write the expression for the solubility product, Ksp, for zinc hydroxide. (0½ mark)

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(c) 5.0 g of zinc hydroxide was shaken in 1 dm^3 of water and the mixture filtered at 25℃.

24.0 cm^3 of the filtrate required 5.6 cm^3 of a 0.1 M hydrochloric acid for complete reaction using phenolphthalein indicator.

Calculate the

(i) solubility product constant, K_{sp} of zinc hydroxide at 25°C. (2½ marks)

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(ii) percentage of zinc hydroxide that dissolved at 25℃. (02 marks)

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(d) State how the solubility of zinc hydroxide would change if its saturated solution at 25℃ is separately treated with.

(i) aqueous zinc sulphate. (1½ marks)

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(ii) ammonia. ($1\frac{1}{2}$ marks)

15. Write a mechanism to show how each of the following conversions can be effected.

(a) Benzene to phenylethanone. (03 marks)

(b) Benzoic acid to 3-nitrobenzoic acid. (03 marks)

(c) 2-iodo-2-methylpropane to 2-methylpropan-2-ol. (03 marks)

16. (a) State:

(i) **Raoult's law**. (01 mark)

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(ii) **three** properties of an ideal solution. (1½ marks)

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(b) An ideal solution of **A** and **B** is such that the mole fraction of **A** is 0.25 at 25℃. Calculate the composition of the vapour above liquid mixture. (*The vapour pressure of pure **A** and pure **B** at 25℃ are 8.000 kPa and 13.332 kPa respectively.*) (03 marks)

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(c) (i) Sketch a labeled boiling point-composition diagram for the mixture in (b) above. (2½ marks)

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(ii) State what would be obtained as the distillate and the residue if a liquid mixture in (b) containing 40% A is fractionally distilled. (01 mark)

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17. (a)(i) Write the formula and the name of one ore from which zinc can be extracted. (01 mark)

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(ii) State the method which can be used to concentrate the ore you have named in a(i). (0½ mark)

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(b) The concentrated ore in (a)(i) was converted to zinc oxide.

(i) State how the conversion was carried out. (01 mark)

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(ii) Write the equation for the reaction that lead to the formation of zinc oxide. (1½ mark)

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(c) The zinc oxide in (b) was mixed with limestone and coke and the mixture heated in air in a blast furnace.

(i) State the purpose of adding limestone. (0½ mark)

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(ii) Write equation for the reaction leading to the formation of zinc. (1½ marks)

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(d) Zinc powder was added to hot concentrated sodium hydroxide solution.

(i) State what was observed. (1½ marks)

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(ii) Write equation for the reaction that took place. (1½ marks)

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END

THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Ti 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

			139 La 57	140 Ce 58	141 Fr 59	144 Nd 60	145 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
			227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Ea 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103