Name ....Centre/Index No........./......

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P525/1
CHEMISTRY
Paper 1
August, 2023
$2\frac{3}{4}$ hours.

JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS –AUGUST, 2023

CHEMISTRY

(Principal Subject)

Paper 1

2 hours 45 minutes.

INSTRUCTIONS TO CANDIDATES:

Answer **ALL** questions in part **A** and Six questions from part **B**.

All questions are to be answered in the spaces provided.

The Periodic Table with relative atomic masses is provided at the back.

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

PART A (46 MARKS)
Attempt all questions in this section

1. (a) State what is meant by the term relative atomic mass. (1 mark)

(b) An element X has five naturally occurring isotopes with isotopic masses and percentage relative abundances shown in the table below.

Isotopic mass	% relative abundance
70	20.55
72	27.37
73	7.67
74	36.74
75	7.67

Calculate the relative atomic mass of X (2 marks)

(c) State two methods used to produce positive ions of X in a mass spectrometer. (1mark)

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2. State what would be observed and write equation for the reaction that takes place when;
   (a) Excess potassium iodide is added to Copper(II) nitrate solution.
   Observation: (1½ marks)

   Equation: (1½ marks)

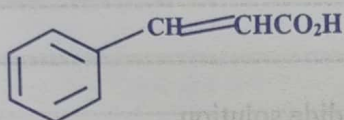
(b) Solid lead(IV) oxide followed by concentration nitric acid is added to aqueous manganese(II)sulphate solution and mixture heated.

Observation: (1 mark)

Equation: (1 ½ marks)

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3. Cinnamic acid ($C_9H_8O_2$) has the structure

CH=CHCO$_2$H

(a) Name the functional groups in cinnamic acid. (1 mark)

(b) Write equation for the reaction between cinnamic acid and;
   (i) Cold aqueous alkaline potassium manganate(VI) solution (1 mark)

   (ii) State what would be observed in b(i). (1 mark)

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4. (a) Determine the oxidation state of aluminium, chromium and iodine in the following species respectively.
   (i) Al_4C_3 (1 mark)

   (ii) $Cr_2O_7^{2-}$ (1 mark)

(iii) IO_3^- (1 mark)

(b) Write equation for the reaction between; (1 ½ marks)
    (i) Al_4C_3 and water

(ii) $Cr_2O_7^{2-}$ and hydrogen peroxide in acidic media

(iii) IO_3^- and acidified potassium iodide solution

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5. The melting points of the oxides of period 3 elements are shown in the table below;

Oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3	Cl_2O_7
Mpt(°C)	920	3802	2027	1700	360	17	-81

(a) State the trend in melting points of the oxides (1 mark)

(b) Explain your answer in (a) (4 marks)

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6. Write equations to show how the following conversions can be effected.
   (i)   2-methylchloropropane from 2-methylpropanoic acid   (2 ½ marks)

   (ii) Phenol from nitrobenzene   (2 ½ marks)

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7. (a) Write;
   (i)   Equation for ionization of phenylethanoic acid in water.   (1 ½ marks)

   (ii) The expression for the ionization constant Ka for phenylethanoic acid.

                                                               (1 mark)

   (b) (i) Calculate pH of 50cm³ solution of 0.2M phenylethanoic acid.   (1 ½ marks)


(ii)   20cm³ of 0.2M solution of sodium phenylethanate was added to the solution in b(i). Calculate the change in pH of solution

(Ka for phenylethanoic acid=5.2 x 10⁻⁵moldm⁻³)   (2 ½ marks)

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8.   (a)(i) State what is meant by Eutectic mixture.   (1 mark)

_____

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(ii)   Give two reasons why eutectic mixture is not a compound   (2 mark)

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(b) Temperature-composition diagram for the sodium nitrate-water system is shown below.
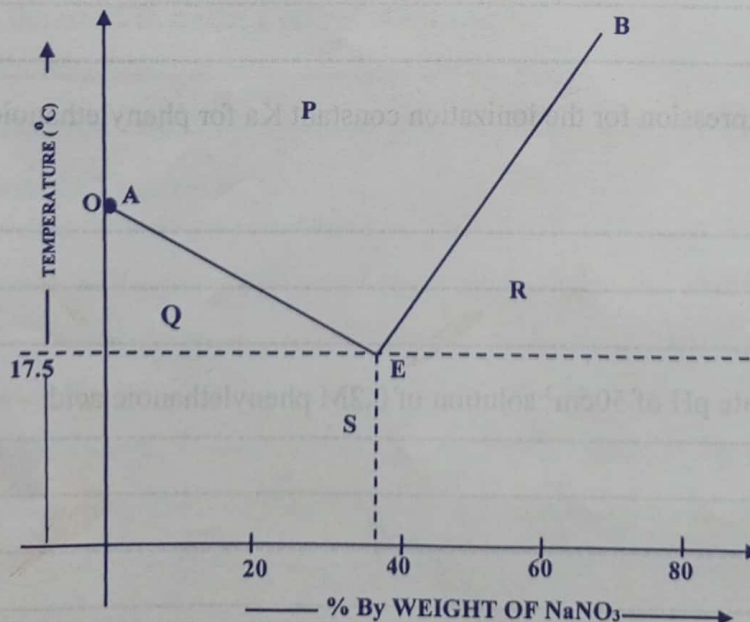
(a) Label phases P, Q, R and S

P;_____ (0 ½ mark)

Q;_____ (0 ½ mark)

R;_____ (0 ½ mark)

S;_____ (0 ½ mark)

(b) What do lines AE and BE represent?

AE;_____ (0 ½ mark)

BE;_____ (o ½ mark)

(c) State what happens at point E   (1 mark)

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9. $20cm^3$ of unsaturated gaseous hydrocarbon P was ignited with $200cm^3$ of oxygen in excess, $140cm^3$ of residual gas was obtained on cooling to room temperature.

On addition of concentrated sodium hydroxide to the residual gas, the volume reduced by $120cm^3$.

(a) Calculate the molecular formula of P.   (3 marks)

(b) Write equations to show how P can be converted to benzene.   (1 marks)

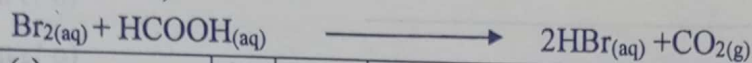---

SECTION B: (54 Marks)

Answer **six questions** from this section.

10. (a) State three methods used to determine rates of chemical reactions. (1 ½ marks)

(b) The table below shows the concentration of bromine at various intervals of time for the reaction;

$$Br_{2(aq)} + HCOOH_{(aq)} \longrightarrow 2HBr_{(aq)} + CO_{2(g)}$$

Times(s)	0	30	60	90	120	180	240	360	480	600
$[Br_2] \times 10^{-3}$ (moldm^{-3})	10	9	8.1	7.3	6.6	5.3	4.4	2.8	2.0	1.3

(i) Plot a graph of concentration of bromine against time. (3 marks)

(ii) Use the graph to find the order of reaction. Explain your answer. (2 marks)

(iii) Calculate the rate constant and state its units (2 ½ marks)

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11. (a) Distinguish between soap and a soapless detergent. (2 marks)

(b) Write equation(s);

(i) for the reaction leading to formation of soap. (1 mark)

(ii) to show how a detergent can be prepared from octadecan-I-ol

$CH_3(CH_2)_{16}CH_2OH$. (3 marks)

(c) Explain why soap cannot be used effectively in;

(i) Hard water (1 ½ marks)

(ii) Strongly acidic solutions (1 ½ marks)

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12. (a) A compound G contains 60.0% carbon, 13.3% hydrogen and the rest being oxygen.

(i) Calculate the empirical formula of G. (2 ½ marks)

(ii) 0.698g of G in 100g of a solvent lowered the freezing point of solvent by 0.190°C. Determine the molecular formula of G

(Kf for solvent = 1.63°C moL^{-1}Kg^{-1}) (2 marks)

(b) When G was reacted with aqueous iodine and sodium hydroxide solution, a yellow Precipitate was formed.

Write the;

(i) Formula and name of G

Formula:_____ (0 ½ mark)

Name:_____ (0 ½ mark)

(ii) Equation leading to the formation of a yellow precipitate. (1 mark)

(c) Write the mechanism for the reaction between G and hot concentrated orthophosphoric acid. (2 ½ marks)

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13. (a) Distinguish between specific conductivity and equivalent conductivity.   (2 marks)

(b) (i) State two factors that can affect the magnitude of specific conductivity   (1 mark)

(ii)   Explain how the factors you have stated in b(i) affect specific conductivity of a weak electrolyte.   (3 marks)

(c) Equivalent conductivities at Zero concentrations at 25°C for some electrolytes are given in the table below.

Electrolyte	Equivalent conductivity (Scm^2mol^{-1})
AgNo3	133.4
KNO3	145.0
KCl	149.9

Use the above data to calculate the;

(i)   Equivalent conductivity at zero concentrations of silver chloride. (1 ½ marks)

(ii)   Solubility product K_s of silver chloride. (Specific conductivity of pure water and a saturated solution of silver chloride are

1.60 x 10^{-6} and 3.14 x 10^{-6} S cm^{-1} at 25°C respectively)   (1 ½ marks)

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14. (a) (i) Write the electronic configuration of chromium.   (1 mark)

(ii)   State the common oxidation states exhibited by chromium in its compounds.

(1 mark)

(iii)   Write the formulae of the oxides of chromium.

(1 ½ marks)

(b) Ammonium dichromate was heated.

(i) State what is observed. (1 ½ marks)

(ii) Write equation for the reaction that takes place. (1 ½ marks)

(c) To the solid product in (b) was added excess concentrated sodium hydroxide solution.

(i) State what is observed. (1 mark)

(ii) Write equation for the reaction that takes place. (1 ½ marks)

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15. Write mechanisms for the reaction between;

(3 marks)

(a) 2-methylpropene and chlorine water.

(b) Propan-2-ol and ethanoylbromide. (3 marks)

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(c) Warm fuming sulphuric acid and benzene. (3 marks)

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16. (a)(i) Write the formula and name of the main ore of aluminium. (1 mark)

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(ii)   Name the impurities present in the ore in (i)

(1 ½ marks)

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(b) Describe how the ore is purified. (4 marks)

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(c) Sodium carbonate solution was added to an aqueous solution of aluminium sulphate. State what is observed and write equation for the reaction that takes place.
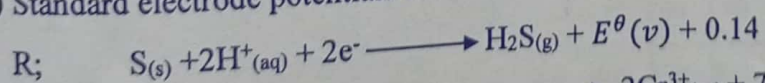
Observation; (2½ marks)

Equation;

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17. (a) State what is meant by the term standard electrode potential of an element. (1 mark)

(b) Draw an energy cycle relating the energy terms that determine the standard electrode potentials of metallic elements. (1 ½ marks)

(c) Standard electrode potentials for some half cell reactions are given below.

R; $S_{(s)} + 2H^+_{(aq)} + 2e^- \longrightarrow H_2S_{(g)} + E^\theta(v) + 0.14$

S; $Cr_2O^{2-}_{7(aq)} + 14H^+_{(aq)} + 6e- \longrightarrow 2Cr^{3+}_{(aq)} + 7H_2O_{(i)} + 1.36$
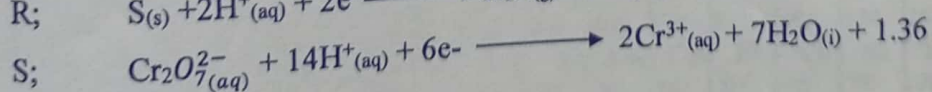
Write the;

(i)   Cell notation of the cell formed when R and S are combined. (1 mark)

(ii)   Overall equation for the reaction that takes place. (1 ½ marks)

(d) Calculate Gibb's free energy for the reaction in c(ii). (F=96500C) (3 marks)

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

(1 mark)

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 Tl 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 Pr 59	144 Nd 60	147 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 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103