

Name.....COMB:.....

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P525/1

CHEMISTRY

PAPER 1

2023

2³/₄HRS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

S.5 END OF TERM ONE 2023

CHEMISTRY EXAMINATION

PAPER 1

2HOURS 45 MINS INSTRUCTIONS:

- *Answer all questions in section A and any six from section B.*
 - *All answers must be written in the spaces provided.*
 - *The periodic table with relative atomic masses is supplied.*
 - *Illustrate your answers with equations where applicable where necessary use the following.*
- *Molar gas constant $R = 8.31 \text{ J.K}^{-1} \text{ mol}^{-1}$*
 - *Molar volume gas at s.t.p is 22.4 litres.*
 - *Standard temperature = 273k.*
 - *Standard pressure = 101325Nm⁻²*

SECTION A (46 MARKS)

Attempt all questions in this section

1. What is meant by isomerism (01 mark)

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(b) Write short notes on the following types of structural isomerism.

(i) Position isomerism (02marks)

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Functional group isomerism (03 marks)

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Chain isomerism (03 marks)

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2 (a)(i) State what is meant by the term first ionization energy (1mark)

[illegible]

(ii) State two factors that can affect the value of first ionization energy and explain how the factors affect the value of first ionization energy

(3marks)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins or other markings on the paper.

(b)(i) Define the term first electron affinity

(01mark)

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(i) Write equation to show the first electron affinity of oxygen

(01mark)

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(v) Explain why the first electron affinity of oxygen is an exothermic process while the second electron affinity is endothermic

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3a) 0.111g of a vaporized sample of an organic compound R occupied 48.0cm³ of 20°C and 700mmHg pressure. Calculate the relative molecular mass of R. (02marks)

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b) R consists of 59.9% carbon, 26.6% oxygen and the rest is hydrogen. Determine

(i) The empirical formula of R.

(02marks)

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(ii) The molecular formula of B.

(1¹/₂marks)

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4a) Write the electronic configuration of elements with following atomic number.

(02marks)

(i) 17.....

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(ii) 20.....

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b) State the group and period of the periodic table in which each of the elements in

(a) above belongs.

(02marks)

	Group	Period
(i)		
(ii)		

5a) Define an ideal gas?

(01mark)

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b) Explain any three differences between real gas and ideal gas.

(05marks)

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c) State the conditions under which the characteristics of a real gas approximate an ideal gas.

(02marks)

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6. 1.363g of compound **Y** containing carbon, hydrogen and bromine on complete combustion gave 1.10g of carbon dioxide and 0.45g of water. When 0.35g of **Y** was vapourised, it occupied 39.5cm³ at 20°C and 750mmHg.

Calculate;

(i) the simplest formula of **Y** (*1 ½ marks*)

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(ii) the molecular formula of **Y** (*2 ½ marks*)

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7. A given volume of alcohol $C_nH_{2n+1}OH$ diffuses through a porous plug in 1.62 seconds. The same volume of oxygen diffuses through a porous plug in 1.18 seconds. Calculate

(i) The molecular mass of $C_nH_{2n+1}OH$

(2marks)

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(ii) The molecular formula of the alcohol.

(1½marks)

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8. a) State any four (4) properties of ionic compounds

(02marks)

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b) Briefly explain why ionic compounds (eg sodium chloride) conduct electricity either in aqueous or molten states but not in the solid state.

(03marks)

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9.(a) Define the term **critical temperature**. (01 mark)

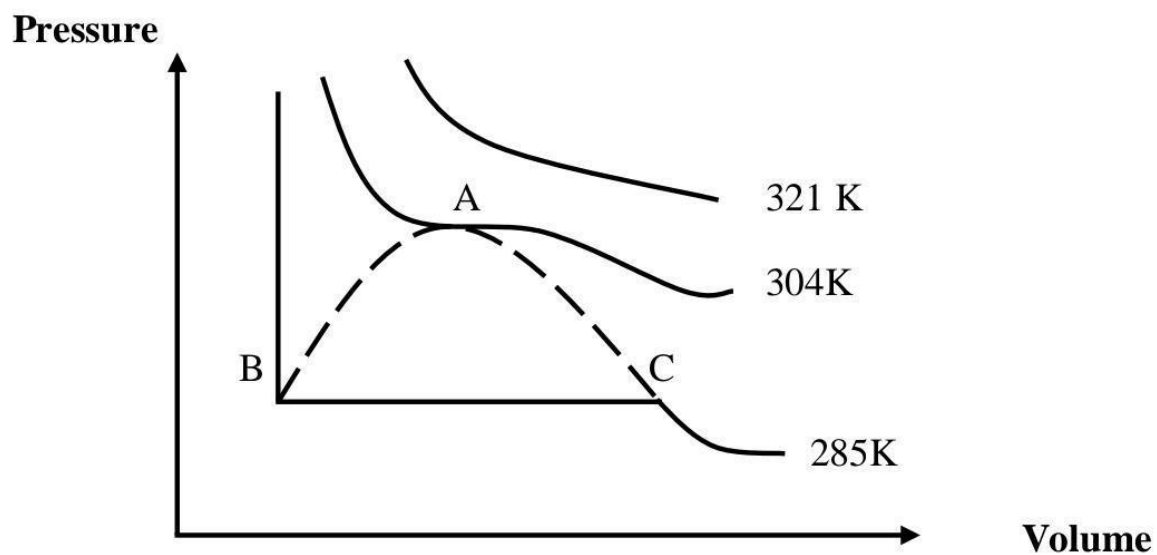
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(b) The diagram below shows isotherms of a gas



(i) What is the critical temperature of the gas. (01 mark)

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(ii) Which isothermal almost represents an ideal gas. (01 mark)

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(iii) What does the region *ABC* represent. (01 mark)

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(c) State two conditions for liquefying a gas. (01 mark)

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SECTION B (54marks)

(Answer any six questions)

10. (a) An organic compound X has molecular formula C_4H_9Br

(i) Name the functional group in X. (01mark)

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(ii) Write the IUPAC names and structural formulae of all the isomers of X.

(03 marks)

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

(i) propionic acid to ethane

(2marks)

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(ii) But-1-ene to Butan-1-ol

(03marks)

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11. (a) (i) State **Hess's law**.

(01 mark)

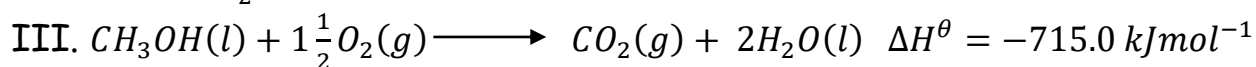
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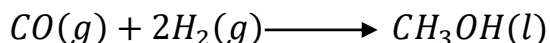
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(ii) The thermochemical data for some reactions at 298K are given below.



Calculate the enthalpy change for the reaction below at 298K; (03 marks)

[illegible]

(b)(I) The standard enthalpy change of formation of tin(IV) chloride is -508 kJmol^{-1} . The standard enthalpy change of atomization of tin and chlorine are $+301 \text{ kJmol}^{-1}$ and $+121 \text{ kJmol}^{-1}$ respectively.

(a) Use the above to construct a Born-Haber cycle for formation of tin(IV) chloride. (03 marks)

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(b)(ii) Calculate the average bond energy of the $\text{Sn} - \text{Cl}$ bond. (02 marks)

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12. The table below shows the atomic radii and ionic radii of the elements in Group II of the Periodic Table.

Element	<i>Be</i>	<i>Mg</i>	<i>Ca</i>	<i>Sr</i>	<i>Ba</i>
Atomic radius(nm)	0.089	0.136	0.174	0.191	0.198
Ionic radius(nm)	0.031	0.065	0.099	0.113	0.135

(a) What is meant by the term **atomic radius**? (01 mark)

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(b) State and explain the trend in atomic radius of the elements.
 (3 $\frac{1}{2}$ marks)

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(c) Explain why the ionic radius is smaller than the atomic radius of corresponding neutral atom for each element. (03 marks)

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(d) Briefly explain how atomic radius and nuclear charge affect the electron affinities of the elements in group II (4 $\frac{1}{2}$ marks)

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13(a)

(i) Define what is meant by the term primary standard (2 marks)

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(ii) State 3 characteristics of a good primary standard

(1 ½ marks)

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(b) Explain the following;

(i) Both dilute hydrochloric acid and nitric acid are not used to acidify potassium manganate (vii) solution

(3 ½ marks)

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(ii) Potassium dichromate (vi) is preferred to potassium manganate (vii) as a primary standard (2 marks)

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14 (a) Calculate the oxidation state of nitrogen and manganese in the following compound and ions. (01mark each)

(i) HNO_3

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(ii) MnO_2

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(iii) Mg_3N_2

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(iv) Mn_2O_3

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b) State what is observed and write the equation for the reaction between;

(i) Acidified potassium dichromate (vi) solution and potassium iodide solution

(2 ½ marks) Observation

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Equation

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(ii) Acidified potassium manganate solution was added to a solution of potassium iodide (2 ½ marks)

Observation

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Equation

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15. Explain the following observations;

(a) Aluminium oxide has a higher melting point than sodium oxide

(3 marks)

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Sodium fluoride has a higher melting point than sodium chloride

(3 marks)

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(b) Beryllium chloride is more soluble in ethanol than in water.

(3 marks)

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16. Successive ionisation energies (kJ mol^{-1}) for some elements in Period 3 of the periodic Table are shown in the table below.

Element	Ionisation energy				
	1 st	2 nd	3 rd	4 th	5 th
Silicon	787	1577	3230	4355	16090
Phosphorus	1060	1896	2908	4954	6272
Sulphur	1000	2258	3381	4565	6995

(a) State and explain the trend in successive ionisation energies.

(03 marks)

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(b) Explain why the;

(i) First ionisation energy of Sulphur is less than that of phosphorus

(03marks)

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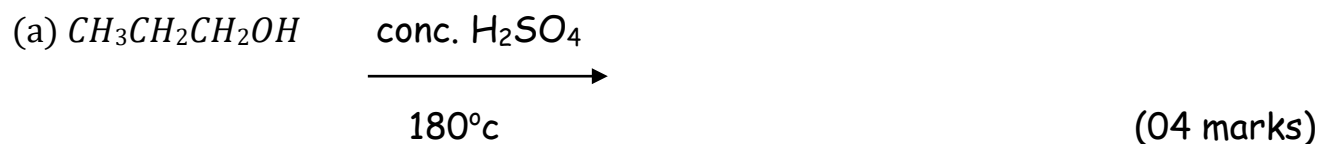
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(ii) third ionisation energy of phosphorus is less than that of silicon.

(03marks)

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17. Complete the following equations and outline a possible mechanism for the reaction in each case.



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END

*Only a fool tests the depth of the
river by both feet*

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

END.