Candidate's Name:

……..

Signature: ……

Random No.					Personal No.		

(Do not write your School/Centre Name or Number anywhere on this booklet)

P525/1
CHEMISTRY
Paper 1
2 ¾ hours

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.

Mathematical tables(3 – figure tables) are adequate or non-programmable scientific electronic calculators may be used

Illustrate your answers with equations where applicable.

Where necessary, use the following:

Molar gas constant R = 8.31 JK^{-1} mol^{-1}

Molar volume of a gas at s.t.p is 22.4 litres.

Standard temperature = 273 K

Standard pressure = 101325 N m^{-2}

For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

Turn Over

SECTION A (46 MARKS)

1. (a) Write the electronic configuration of element Gallium (Ga)

(½ marks)

.....

(b) Natural gallium consists of isotopes ^{69}Ga and ^{71}Ga in atomic ratio 3:2. The relative isotopic masses of ^{69}Ga and ^{71}Ga are 68.9 and 70.9 respectively. Calculate the approximate relative atomic mass of Gallium.

(1½ marks)

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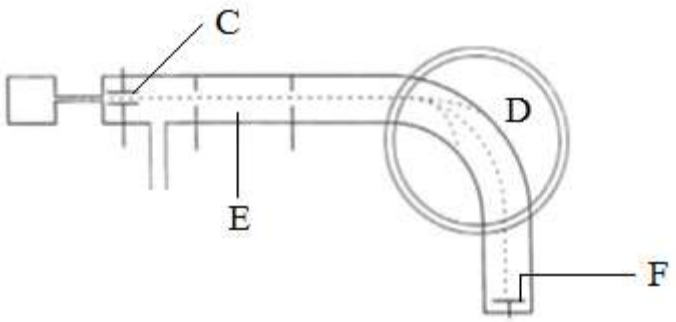
(c) The figure below represents a mass spectrometer.



Name and state the function of parts

C ……

D ……

E ……..

F ……..

2. Sodium benzoate undergoes hydrolysis.

(a) Write

(i) equation for hydrolysis of sodium benzoate *(1½ marks)*

.....

(ii) the expression for the hydrolysis constant (K_h) for sodium benzoate *(½ marks)*

.....

(b) The hydrolysis constant (K_h) of a 0.10 M solution of sodium benzoate at 25^{o}C is 1.6×10^{-10} mol l^{-1} Calculate the pH of solution.

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3. (a) (i) What is meant by the term **thermosetting plastic**? *(01 mark)*

……

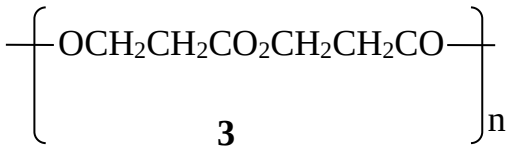
……

(ii) Name **two** thermosetting plastics *(01 mark)*

……

……

(b) A polymer has the structure



(i) Write the structure of the monomer *(01 mark)*

……

(ii) State the type of polymerization reaction leading to the formation of the polymer *(½ marks)*

……

(c) When 5 x 10^{-3} moles of this polymer was hydrolysed 9.0 g of monomer was obtained. Calculate value of n *(2 marks)*

……

……

……

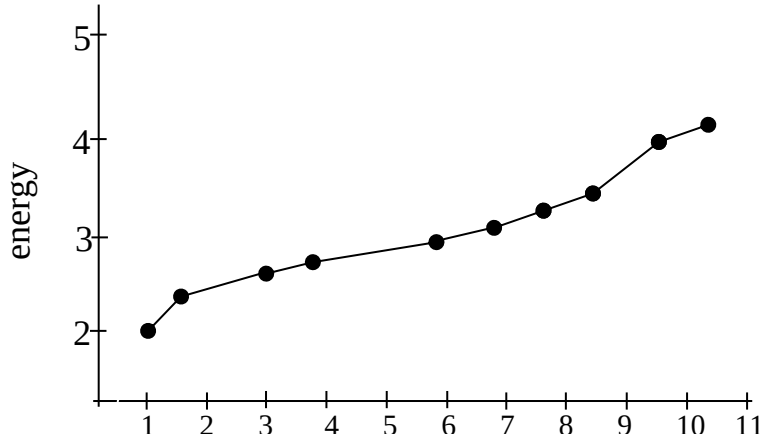
4. (a) State factors that can effect ionization energy *(1½ marks)*

.....

.....

.....

(b) The figure 1.1 below shows the energy required to remove successively each electron from an atom Z, until all electrons are removed.



Explain the shape of the graph *(2½ marks)*

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5. (a) What is meant by the term **ebullioscopic constant** *(01 mark)*

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.....

.....

(b) (i) 2.7 g of ethanamide (CH_3CONH_2) was dissolved in 75g of ethanol Calculate the boiling point of the resultant solution
[ebullioscopic constant, Kb of ethanol is 1.15$^oC\ mol^{-1}kg^{-1}$ and the boiling point of ethanol is 78^oC]

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(ii) State any **two** assumptions made in the calculation in b (i) above. *(01 mark)*

.....

.....

6. Complete the following organic reactions and give the systematic (**IUPAC**) names of the main organic product in each case

(a) $(CH_3)_2C = CH_2 \xrightarrow{HCl}$ ……..

.....

(b) $HOCH_3 + CH_3CH_2COOH \underset{\text{warm}}{\overset{\text{conc. } H_2SO_4}{\rightleftharpoons}}$ ……..

.....

(c) n $CH_2 = CH$–  $\xrightarrow[\text{Heat, high pressure}]{ROOR}$ ……

.....

(d) $(CH_3)_3CCl \xrightarrow[\text{heat}]{NaOH(aq)}$ ……

.....

7. (a) State **three** characteristic properties of copper as a transition metal element. *(1½ mark)*

.....

.....

.....

(b) (i) Write the electronic configuration of copper

.....

(ii) State the common oxidation states exhibited by copper in its compounds *(01 mark)*

.....

(c) State what is observed and in each case write equation of reaction that takes place when the solution containing Cu^{2+} ions was added to

(i) 1 cm^3 of potassium hexacyanoferrate (II) solution *(1½ marks)*

Observation

……

Equation

……

(ii) magnesium powder *(1½ marks)*

Observation

……

Equation

……

8. A cell was constructed as shown below

$Pt/Cr^{2+}(aq), Cr^{3+}(aq) // MnO_4^-(aq), Mn^{2+}(aq), H^+(aq)/Pt$

(a) Write equations for the reactions that occur at the:

(i) Anode

……

(ii) cathode

……

(b) Using the equations in a(i) and a(ii), write the overall cell reaction. *(1½ marks)*

……

(c) The electrode potentials for the systems Cr^{2+}/Cr^{3+} and Mn^{2+}/MnO_4^- are – 0.402 and + 1.52 volts respectively. Calculate the cell voltage.
(1½ marks)

……

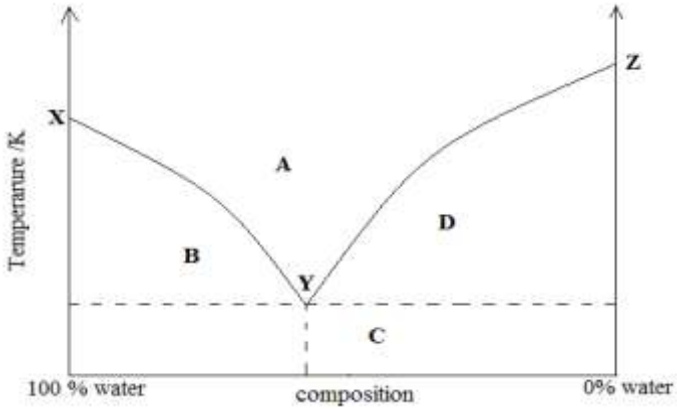
……

9. (a) What is meant by the term **eutectic mixture**?

……

……

(b) Figure 1.2 below shows the phase equilibrium diagram for sodium chloride – water system



(i) Name the point **X**, **Y** and **Z** *(1½ marks)*

X …….

Y ……

Z …….....

(ii) Label phases **A**, **B**, **C** and **D** *(2 marks)*

A ……

B ……

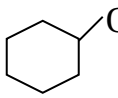
C …….

D …….....

SECTION B: (54 MARKS)

Answer **six** *questions from this section.*
Additional questions answered will **not** *be marked.*

10. Complete the following organic reactions and write the accepted mechanisms.

(a)  $\xrightarrow{H^+/H_2O}$ ……*(3 marks)*

……

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……

……

(b) $(CH_3)_2CO \xrightarrow{NaHSO_3(aq)}$ ……*(3 marks)*

……

……

……

……

(c) $CH_3CH{=}CH_2 \xrightarrow[H_2SO_4(aq)/\text{ heat}]{H_2O}$ ……*(3 marks)*

……

……

……

……

11. (a) State factors that can affect melting points of elements or compounds *(2 marks)*

……

……

(b) The melting points of elements in group IIA in the periodic table are given below

Element	Be	Mg	Ca	Sr	Ba	Ra
mpt/^{o}c	1556	923	1123	1043	998	973

State the trend and explain the variation in trend of the melting points *(05 marks)*

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……

(c) Group (II) metals form few complexes. However, the tendency to form complexes decreases down the group. Explain this observation *(02 marks)*

……

……

……

11. State what is observed when the following substance are mixed in each case illustrate your answer with an equation

(a) Aluminium powder is added to an aqueous solution of iron (III) chloride**.** *(03 mark)*

Observation:

……

Equation:

……

(b) 2 drops of Brady's reagent is added to a dilute solution of propanal. *(03 marks)*

Observation:

……

Equation:

……

(c) Hydrogen sulphide gas is passed through a concentrated solution of nitric acid. *(03 marks)*

Observation:

……

Equation:

……

13. (a) What is meant by the term a **ligand** *(01 mark)*

……

……

……

(b) Explain why transition metals commonly act as catalysts in chemical reactions

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……

……

……

(c) In each case write equation of reaction catalysed by the following ions/species. *(1½ marks)*

(i) Vanadium pentoxide (V_2O_5)

……

(ii) Iron (Fe) *(1½ marks)*

……

(iii) Manganese(IV) oxide (MnO_2) *(1½ marks)*

……

(d) Determine the Coordination number and Oxidation State of the central metal atom/ion in the following complexes. *(2 marks)*

Complex	**Coordination number**	**Oxidation state**
$Fe(CN)_6^{4-}$		
Cr $(H_2O)_6Cl_3$		

14. (a) State conditions under which the partition law is valid *(1½ marks)*

……

……

……

(b) An aqueous solution of 500cm^3 of **A** containing 5.00g of **A** was extracted by 100cm^3 of ether and two successive portions of 50.0cm^3 of ether. (The partition coefficient of **A** between ether and water is 90) Calculate the mass of **A** extracted by

(i) 100 cm^3 of ether *(2½ Marks)*

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(ii) Two successive portions of 50.0 cm^3 of ether *(4½ Marks)*

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(iii) Comment on the results in b(i) and b(ii) *(01 mark)*

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……

15. Name the reagent that can be used to distinguish between the following organic compounds in each state what is observed if each compound is separated treated with the reagent.

(a) $(CH_3)_2C=O$ and $CH_3CH_2\overset{O}{\overset{\|}{C}}-H$ *(03 marks)*

Reagent:

……

Observations

……

……

(b) $(CH_3)_3COH$ and $(CH_3)_2CHOH$ *(03 marks)*

Reagent:

……

Observations

……

……

(c) HCOOH and HOOCCOOH *(03 marks)*

Reagent:

……

Observations

……

……

16. Hydrogen iodide decomposes when heated according to the equation

$$2HI\ (g) \rightleftharpoons H_2(g) + I_2(g), \qquad \Delta H = +11.3\ kJ\ mol^{-1}$$

(a) Write the expression for the equilibrium constant, K_c for the reaction

……

(b) 3.10g of hydrogen iodide was heated in 600 cm^3 bulb 400 ^oC. When equilibrium is attained the bulb was rapidly cooled to room temperature and broken under potassium iodide solution. The iodine formed from the decomposition requires 13**.**40cm^3 of 0.2M sodium thiosulphate solution for complete reaction.

(i) Explain why the bulb was rapidly cooled? *(1½ marks)*

……

……

(ii) Calculate the value of the equilibrium constant (K_c) at 400^{o}C *(05 marks)*

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……

……

(c) State what could happen to the value of K_c when

(i) Temperature is increased.

……

(ii) Neon gas is added.

……

(iii) Volume of bulb is increased to 1000 cm^3

……

17. (a) Draw the structure and name the shape adopted by the following molecules. *(4 marks)*

Molecule	**Structure**	**shape**
$BeCl_2$		
H_2S		

(b) Explain why the molecules adopt the shapes you have stated in (a) above.

(i) $BeCl_2$ *(2½ marks)*

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……

……

……

(ii) H_2S *(2½ marks)*

……

……

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PERIODIC TABLE

1	2											3	4	5	6	7	8
1 H 1.0																1 H 1.0	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 103	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Ti 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)															
			57 La 139	58 Ce 140	59 Fr 141	60 Nd 144	61 Pm (145)	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
			89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf 251	99 Ea (254)	100 Fm (257)	101 Mv (256)	102 No (254)	103 Lw 260

END