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) Methylamine is a weak base
   i) What is **weak base**? *(1 mark)*

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   ii) Write the equation for the ionization of methylamine. *(1 mark)*

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   iii) Write the expression for the ionization constant of methylamine. *(1 mark)*

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   b) i) Calculate the hydrogen ion concentration in a 0.02M solution of methylamine. $(K_b = 4.4 \times 10^{-4}; K_w = 1 \times 10^{-14}$ at $25^oC)$. *(3 marks)*

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   ii) Calculate the pH of the solution. *(1 mark)*

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2. Name the reagent that you would use to distinguish between the following pairs of compounds. In each case state what you would observe when the reagent is treated with each member of the pair.

a) $(CH_3CH_2)_2NH$ and $CH_3CH_2NH_2$ *(2 marks)*

Reagent:

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Observations:

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b) CH_3CH_2OH and CH_3OH *(2 marks)*

Reagent:

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Observations:

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c) $HCOOH$ and CH_3COOH *(2 marks)*

Reagent:

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Observations:

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3.   Write the ionic equation for the reaction between sodium hydroxide and
     (a)   Silicon(IV) oxide   (1 ½ marks)

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     (b)   Aluminium   (1 ½ marks)

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     (c)   Zinc oxide   (1 ½ marks)

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4.   a)   i)   Define a '**complex ion**'.   (2 marks)

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         ii)   Explain why transition metals form complexes.   (2 marks)

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     (b)   Complete the following table about complexes of chromium and cobalt.
                                                                (2 marks)

Complex	Oxidation state of metal ion	Co-ordination number
$[Cr(NH_3)_6]^{3+}$		
$[CO(NH_3)_4(H_2O)_2]Cl_2$		

5. State what you would observe and write an ionic equation for the reaction between aqueous copper(II) sulphate solution and:

    (a)   Excess concentrated hydrochloric acid   *(2 ½ marks)*

Observation

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Equation

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    (b)   Aqueous potassium iodide solution.   *(2 ½ marks)*

Observation

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Equation

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6. Excess magnesium was added to 100 cm^3 of 0.2 M copper(II) sulphate solution. The temperature rose by 16.9 °C.

    a)   Write an equation for the reaction.   *(1½ marks)*

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    (b)   Calculate the enthalpy of the reaction. *(Density of the solution is 1.0 g/cm^3. Specific heat capacity of the solution is 4.2 J/g/°C).*
                                                (2½ marks)

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7. a) Define:
   i) **Bond energy**.   *(1 mark)*

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   ii) **Heat of formation**.   *(1 mark)*

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(b) Given the following bond energies.

Bond	Bond energy (kJ/mole)
C – C	337
C – H	414
C – O	360
O – H	123

Calculate the heat of conversion of gaseous methoxymethane to gaseous ethanol.   *(2 marks)*

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8. a) An alkyne X has molecular formula C_4H_6. Write the names and structural formulae of all possible isomers of X.   *(2 marks)*

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(b)   **X** reacts with an ammoniacal solution of silver nitrate.
    i)   State what is observed.   *(½ mark)*

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    ii)   Write the equation for the reaction that takes place.   *(1 mark)*

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  c)   Write equations to show how **X** can be synthesized from ethane.
                                                                      (4 marks)

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9.   Draw the molecular structures of the following species.   *(2 marks)*

species	Shape
(a) SO_3	
(b) Cl_2	
(c) H_2S	
(d) SO_4^{2-}	

SECTION B: (54 MARKS)
*Answer **six** questions from this section.*
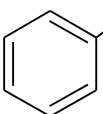*Additional questions answered will **not** be marked.*

10. Write equations to show how the following compounds can be synthesized. Indicate the reagents and conditions.

   a) $(CH_3)_2C = NOH$ from propane – 2 – ol. *(2 marks)*

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   b) NH·CH$_2$CH$_3$ from benzene *(3 marks)*

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   c) $CH_3CH_2C \equiv CCH_2CH_2CH_3$ from But-l-ene. *(2 marks)*

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   d) Benzoic acid from chlorobenzene. *(2 marks)*

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11. (a) Write the formula and name of **one** ore of aluminium. *(1 mark)*

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(b) In the extraction of aluminium, the ore is first digested with sodium hydroxide solution. Describe what happens and write equations for the reactions that take place. *(3 marks)*

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(c) Name the steps that are carried out after digesting the ore with sodium hydroxide. *(3 marks)*

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(c) Describe how pure aluminium is obtained from the purified ore.
Write the equation for the reaction. *(2 marks)*

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12. a) Define
    i) **Conductivity**. *(1 mark)*

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    ii) **Molar conductivity** *(1 mark)*

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(b) The electrolytic conductivity of a 0.1 M ethanoic acid at 20° C is 1.96 x 10^{-2} Sm^{-1}. Its molar conductivity at infinite dilution is 3.52 x 10^{-2} S m^2 mol^{-1}.
Calculate:
    i) The molar conductivity of ethanoic acid at 20°C. *(2 marks)*

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    ii) The degree of ionization of the acid at 20°C. *(1 mark)*

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    iii) The pH of the acid *(2 marks)*

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(c) State **two** other factors other than concentration that can affect the pH of the acid. *(2 marks)*

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13. a) State **three** properties exhibited by chromium as a transition metal.

(3 marks)

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(b) An aqueous solution of iron(II) salt was added to an acidified solution of chromium in the oxidation state of +6.

i) State what was observed. *(1 mark)*

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ii) Write half equations and the overall equation for the reaction that took place *(3 ½ marks)*

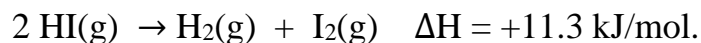...

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(c) i) State **one** application of chromium in the oxidation state of +6 in organic synthesis. *(½ mark)*

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ii) Write the equation to illustrate your answer. *(1 mark)*

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14. Hydrogen iodide decomposes according to the equation.

$$2\,HI(g) \rightarrow H_2(g) + I_2(g) \quad \Delta H = +11.3\ kJ/mol.$$

a) Write an expression for the equilibrium constant (K_c) of the reaction. *(½ mark)*

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(b) 2.56 g of hydrogen iodide was heated in a 600 cm^3 bulb at 500 ºC. At equilibrium the bulb was rapidly cooled to room temperature and broken under potassium iodide solution. The iodine liberated required 33.5 cm^3 of 0.2 M sodium thiosulphate for complete reaction. Calculate

i) The number of moles of hydrogen iodide that were heated.

(1 mark)

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ii) The number of moles of iodine that were formed from the decomposition. *(2½ marks)*

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iii) The value of K_c for the reaction at 500 ºC. *(3½ marks)*

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(c) i) State what would happen to the value of K_c if the temperature changed from 500 ºC to 200 ºC *(½ mark)*

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ii)   Explain your answer.   *(1 mark)*

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15.   a)   What is meant by "**hydrolysis of a salt**"?   *(1 mark)*

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(b)   A solution was made by dissolving 2.675 g of ammonium chloride in water to make 1 litre of solution.

(i)   Write the equation for the hydrolysis of ammonium chloride.
                                                              (1½ marks)

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(ii)   Calculate the hydrogen ion concentration and hence the pH of the solution in (b) above   *(5 marks)*

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ii)   The degree of hydrolysis.
       $(K_w = 1 \times 10^{-14}$ at $25^{o}C, K_h = 1.75 \times 10^{-5})$ *(1½ marks)*

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16.   a)   Define **partition coefficient**.   *(1 mark)*

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(b)   50 cm^3 of 1.5 M ammonia solution was shaken with 50 cm^3 of
trichloromethane. At equilibrium 20 cm^3 of the trichloromethane layer
required 23 cm^3 of 0.05 M hydrochloric acid. Find the partition
coefficient of ammonia between water and trichloromethane.
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(c)   25 cm^3 of excess ammonia was added to 25 cm^3 of 0.1 M
copper(II) sulphate solution. 50 cm^3 of trichloromethane was added.
The mixture was shaken and allowed to stand. 20 cm^3 of the
trichloromethane layer required 10.2 cm^3 of 0.05 M hydrochloric acid
for complete reaction. 10 cm^3 of the aqueous layer required 16.5 cm^3 of
0.5 M hydrochloric acid.
   i)   Find the concentration of ammonia in the trichloromethane layer.
                                                                  (1½ marks)

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ii)   Find the concentration of free ammonia in the aqueous layer
(1 mark)

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iii)   Find the concentration of ammonia in the complex.
(1½ marks)

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iv)   Determine the formula of the complex.   *(1 mark)*

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17.   Agricultural lime is manufactured by heating limestone strongly in a kiln. The product is allowed to cool and a calculated amount of water in added.
a)   Write the equations for the reactions that take place   *(2 marks)*

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b)   Give one use of lime in agriculture.   *(1 mark)*

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c) Explain the trend in the thermal stability of carbonates of group(II) metals. *(2½ marks)*

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d) The mineral "Dolomite" has formula $Ca\ CO_3.MgCO_3$. 2.5 g of Dolomite was reacted with excess hydrochloric acid. 230 cm^3 of carbon dioxide was evolved at room temperature.

    i) Write the equation for the reaction.

(1 mark)

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    ii) Calculate the percentage of 'Dolomite' in the sample.

(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

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1.   **H – indicates Atomic number**

2.   **H – indicates relative Atomic mass**
   1.0

END