Candidate's Name:

.....

Random No.					Personal No.		

Signature: .....

(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

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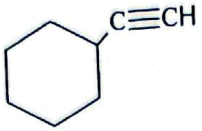
SECTION A (46 MARKS)

1. Name the reagent(s) that can be used to distinguish between the following compounds. In each case state what would be observed when each compound is separately treated with the reagent.

(a)  and  *(2 marks)*

Reagent(s)

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Observation:

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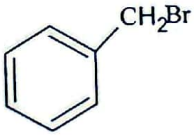
(b)  and  *(2 marks)*

Reagent(s)

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Observation:

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2. (a) A buffer solution was obtained by mixing 8.3 g of ethanoic acid and 16 g of sodium ethanoate in 1 litre of distilled water. Calculate the pH of the buffer solution if 0.70 cm^3 of 1 M hydrochloric acid is added. *[the acid dissociation constant, K_a, for ethanoic acid at 25°C is 1.8 × 10^{-5} mol l^{-1}]* *(3 ½ marks)*

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(b) State **two** applications of buffer solutions *(1 mark)*

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3. Complete the following equations and in each case name the major product(s)

(a) $(CH_3COO)_2Ca \xrightarrow{heat}$ .....

Name of product *(1 ½ marks)*

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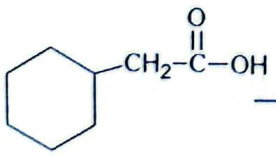
(b) 

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Name of product *(1 ½ marks)*

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(c) $CH_3CH_2CON(CH_3)_2 \xrightarrow[heat]{\bar{O}H/H_2O}$ .....

(3 marks)

Name of product(s)

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4. (a) The following data of results was obtained for the reaction

$$2NO_{(g)} + Cl_{2(g)} \rightleftharpoons 2NOCl_{(g)}$$

Experiment No.	Initial concentration (mol dm^{-3})		Initial rate $\frac{d[NOCl]}{dt}$ (mol l^{-1} s^{-1})
	$[Cl_2]$	[NO]	
1	0.10	0.10	1×10^{-4}
2	0.10	0.20	4×10^{-4}
3	0.30	0.10	3×10^{-4}

(i) Deduce the order of reaction with respect to

- Chlorine *(1 mark)*

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- Nitrogen(II) oxide *(1 mark)*

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(ii) Write the rate equation for the reaction. *(1 mark)*

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(b) Calculate the rate constant, **K**, for the reaction and state its units.

(2 marks)

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5. A white crystalline solid **Z** decomposes on heating leaving a yellow residue. When **Z** is warmed with concentrated sulphuric acid, a gas is evolved which burns with a blue flame and had no effect on lime water. **Z** dissolves in dilute nitric acid forming a colourless solution. The solution decolourises alkaline potassium manganate(VII) solution and forms a reddish-brown solution when reacted with iron(III) chloride.

(a) Identify **Z** *(1 mark)*

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(b) Write equations for the reactions that took place when **Z**

(i) Decomposed to a yellow residue *(1 ½ marks)*

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(ii) was warmed with concentrated sulphuric acid *(1 ½ marks)*

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(iii) solution was reacted with iron(III) chloride *(1 ½ marks)*

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6. State what is observed and write the ionic equations when each of the following pairs of substances are mixed.

(a) Aqueous solution of copper(II) sulphate and potassium iodide. *(02 marks)*

Observation

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Equation

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(b) Zinc metal and aqueous solution of Iron(III) chloride. *(02 marks)*

Observation

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Equation

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(c) A saturated aqueous solution of sulphur dioxide and aqueous solution of potassium manganate(VII). *(02 marks)*

Observation

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Equation

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7. The standard electrode potentials for some half-cell reactions are given below

Half-cell reaction	E^{θ}/V
$MnO^{-}_{4(aq)} + e^{-} \rightarrow MnO^{2-}_{4(aq)}$	+0.56
$MnO^{2-}_{4(aq)} + 2H_2O_{(l)} + 2e^{-} \rightarrow MnO_{2(s)} + 4\bar{O}H_{(aq)}$	+0.60
$MnO^{-}_{4(aq)} + 8H^{+}_{(aq)} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$	+1.52
$Br_{2(aq)} + 2e^{-} \rightarrow 2Br^{-}_{(aq)}$	-1.06

(a) Write the

(i) cell convention of the cell formed when bromine half-cell is combined with the cell of acidified potassium manganite(VI) *(1 mark)*

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(ii) Overall cell reaction in a(i). *(1 ½ marks)*

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(b) Calculate the electromotive force of the cell in (a). *(1 mark)*

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(c) State what would happen when a solution of potassium manganate(VI) is exposed to air and write equation for the reaction that took place.
(2 marks)

Observation:

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Equation

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8. Draw the structures and name the shapes for the following species.
(4½ marks)

species	Structure	Name
(i) SO_2		
(ii) H_2S		
(iv) SO_4^{2-}		

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9. (a) Explain briefly why chlorine is a stronger oxidising agent than bromine. *(2 marks)*

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(b) Write equation(s) for the reaction of chlorine and bromine with

(i) cold dilute sodium hydroxide.

Chlorine *(1½ marks)*

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Bromine *(1½ marks)*

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(ii) hot concentrated sodium hydroxide

Chlorine *(1½ marks)*

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Bromine *(1½ marks)*

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SECTIONB

(Attempt any six questions)

Additional questions answered will **not** *be marked.*

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

(a) ethene to propanoic acid *(03 marks)*

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(b) bromobenzene to phenol *(03 marks)*

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(c) benzene to poly phenylethene *(03 marks)*

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11. Explain each of the following observations

(a) Berrylium carbonate is thermally less stable than calcium carbonate *(03 marks)*

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(b) Aluminium fluoride is purely ionic whereas aluminium bromide is covalent

(03 marks)

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(c) The boiling points of tertiary amines are lower than those of primary amines with the same molecular masses. *(03 marks)*

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12. Sulphur dioxide reacts with oxygen according to the following equation:

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \quad \Delta H^{\phi} = -97\ kJ\ mol^{-1}$$

(a) State the actual conditions for the reaction that favour maximum yield of sulphur trioxide.

(1½ marks)

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(b) State what would happen to the concentration of sulphur trioxide in the equilibrium mixture and give a reason for your answer if

(i) the temperature is increased *(1½ marks)*

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(ii) nitrogen gas is added to the mixture at constant pressure. *(1½ marks)*

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(c) The equilibrium mixture of the above reaction at 700°C was found to contain 0.40 mol of sulphur dioxide, 0.30 mol of oxygen and 1.00 mol of sulphur trioxide in a 2 litre vessel.

(i) Write the expression for the equilibrium constant, K_c. *(1 mark)*

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(ii) Calculate the value of K_c for the reaction at 700°C. *(3½ marks)*

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13. Complete the following equations and in each case write the accepted mechanisms for the reactions

(a) $CH_3CH_2\overset{O}{\overset{\|}{C}}H \xrightarrow[H^+]{Na_2SO_3}$ .....

(03 marks)

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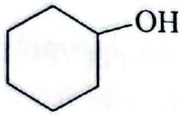
(b)  $\xrightarrow[\text{heat}]{H_3PO_4}$ .....

(03 marks)

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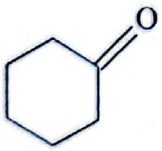
(c)  $\xrightarrow{NH_2NH_2/\,H^+}$ .....

(03 marks)

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14. (a) A compound **P** contains carbon, hydrogen and oxygen. When 0.0219 g of P was burnt, it gave 0.0581 g of carbon dioxide and 0.0239 g of water Calculate the empirical formula of P *(3½ marks)*

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(b) When 0.140 g of P was vapourised at 20°C at 740 mm Hg pressure, it occupied a volume of 39.5 cm^3.

(i) Calculate the molecular mass of P *(2 marks)*

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(ii) Determine the molecular formula of P. *(1 mark)*

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(c) When P was treated with sodium hydrogen carbonate, effervescence of a colourless gas occurred. P gave a brown precipitate when heated with iron(III) chloride solution.

(i) Identify P *(1 mark)*

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(ii) Write equation of reaction for the formation of the brown precipitate *(1½ marks)*

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15. a) Briefly describe the physical principles involved in the separation of two immiscible liquids *(2½ marks)*

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(b) Phenylamine and water are immiscible liquids. The saturated vapour pressures of pure phenylamine and pure water at various temperatures are given in the table below.

Temperature/°C	85	90	95	100	105
Phenylamine: Vapour pressure (kPa)	3.0	3.9	4.9	6.1	7.3
Water: Vapour pressure (kPa)	57.9	70.1	84.5	101.3	120

(i) Plot on the same axes graphs of phenyl amine, pure water and the mixture against temperature. *(3 marks)*

(ii) Using the graphs, determine and state the temperature at which the mixture of phenylamine and water boils
[atmospheric pressure = 101.325 kPa] *(1 mark)*

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(iii) Calculate the percentage by mass of phenylamine if the distillate mixture was steam distillate. *(2 marks)*

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(c) State one advantage of steam distillation over fractional distillation. *(½ mark)*

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16. (a) Compare the thermal stabilities of silicon(IV) chloride and tin(IV) chloride. *[Include equations of reactions if any]* *(2 marks)*

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(b) State conditions of reaction between tin and chlorine and write equation of the reaction that took place. *(2½ marks)*

Conditions

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Equation

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(c) Silicon(IV) chloride was dissolved in water.

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

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

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(d) When 0.325 g of silicon(IV) chloride was dissolved in water, the resultant solution required 48 cm^3 of 0.1 M sodium hydroxide for complete neutralisation. Calculate the percentage purity of silicon(VI) chloride. *(2 marks)*

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17. (a) Silver ethanedioate is sparingly soluble in water. Write:

(i) equation for the solubility of silver ethanedioate in water. *(1½ marks)*

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(ii) the expression for the solubility product, K_{sp} of silver ethanedioate. *(½ mark)*

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(b) The solubility product, *Ksp*, of silver ethanedioate is 5.3×10^{-2} mol^3l^{-3} at 25°C. Calculate the concentration of the following ions in a saturated solution of silver ethanedioate.

(i) Silver ions. *(2½ marks)*

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(ii) Ethanedioate ions *(½ mark)*

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(c) Calculate the mass of silver nitrate should be added to the saturated solution in (b) in order to reduce the concentration of the ethanedioate ions to a fifth of its original value. *(2½ marks)*

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(d) Sodium ethanedioate solution was added to the solution in (b). State how the concentration of the silver ions was affected and give a reason for your answer. *(1½ marks)*

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Reason.....

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