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

Signature:..... School: .....

P525/1
CHEMISTRY
Paper 1
July/August 2018
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 relevant atomic masses is supplied at the end of the paper.

Mathematical tables (3- figure) and non-programmeable electronic calculators may be used.

Illustrate your answers with equations where applicable.

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

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

Standard temperature = 273 K

Standard pressure = $101325Nm^{-2}$

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

SECTION A (46 MARKS)

1. State what would be observed and write equation for the reaction when;

(a) Manganese (II) sulphate solution is reacted with nitric acid followed by solid sodium bismuthate.

Observation *(01 mark)*

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Equation *(01½ mark)*

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(b) Excess potassium iodide is added to copper (II) nitrate;

Observation *(01 mark)*

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Equation *(01½ mark)*

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2. (a) Propan -1-ol reacts with concentrated orthophosphoric acid (H_3PO_4) when heated to form compound Z. Write equation for the reaction and outline the mechanism. *(03 marks)*

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(b) Compound Z in (a) can be synthesized form a secondary alkylhalide. Write equation and outline a mechanism for the reaction. *(2½ marks)*

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3. (a) Define the term standard heat of formation of a substance. *(01 mark)*

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(b) The standard enthalpy of atomization of graphite and hydrogen are +715 and +218 kJmol^{-1}. The standard enthalpy of formation of ethane is +52 kJ mol^{-1}.

(i) Using a Born – Haber cycle, calculate the standard heat of formation of ethene from gaseous atoms. *(02½ marks)*

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(ii) The mean bond energy for the C – H bond in 415 KJmol^{-1}. Determine the value of the mean bond energy for the C=C bond. *(02 marks)*

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4. (a) (i) Write the formula of the oxides of tin. *(01 mark)*

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(ii) State the oxidation states of tin each oxide. *(01 mark)*

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(b) Sodium hydroxide solution was added to an aqueous solution of tin (II) chloride dropwise until in excess.

(i) State what was observed. *(01 marks)*

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(ii) Write equation(s) for the reaction(s) that took place. *(02 marks)*

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5. (a) Draw the molecular shapes of the following species. *(03 marks)*

	Species	**Shape**	**Names**
(i)	NH_4^+		
(ii)	SF_4		
(iii)	NO_2^-		

(b) Explain why the anion (iii) adopts the shape. *(02 marks)*

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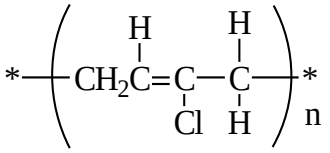
6. (a) The structure of neoprene is;



(i) Write the structure and IUPAC name of the monomer of neoprene. *(01 mark)*

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(ii) When 1.10g of the monomer was polymerized, 2.59×10^{-4} moles of neoprene was formed. Determine the number of monomer units in the neoprene. *(04 marks)*

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7. A crystalline solid **P** dissolves in water to form a colourless solution. Addition of ammonia solution and disodium hydrogenphosphate in ammonium chloride to the aqueous solution produced a white crystalline precipitate slowly. The aqueous solution formed a white precipitate soluble in ammonia solution when silver nitrate solution was added.

(a) i) Identify solid **P** *(01 mark)*

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ii. What is the role of magnesium chloride? *(01 mark)*

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iii. Write equations for the reactions that took place. *(03 marks)*

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8. A solution contains 2.0g of propane -1,2,3–triol in 60g of water;

(a) Calculate the boiling point of the solution at 760 mmHg.
(C=12, H=1, O=16, K_b for water = $0.52^0c\ mol^{-1}\ kg^{-1}$) *(03 marks)*

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(b) State any two assumptions you made in the calculation. *(02 mark)*

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9. The initial rate of the reaction between the gases NO and H_2 was measured in a series of experiments at a constant temperature and the following rate equation was determined. rate = $k[NO]^2[H_2]$

(a) Complete the table of data below for the reaction between NO and H_2

Experiment	Initial [NO] / mol dm^{-3}	Initial [H_2] / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	3.0×10^{-3}	1.0×10^{-3}	1.8×10^{-5}
2	3.0×10^{-3}		7.2×10^{-5}
3	1.5×10^{-3}	1.0×10^{-3}	
4		0.50×10^{-3}	8.1×10^{-5}

(03 marks)

(b) Using the data from experiment 1, calculate a value for the rate constant, *k*, and state its units. *(2 marks)*

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SECTION B (54 MARKS)

10. (a) Gas **Y** contains 50% sulphur, the rest being oxygen. Methane diffuses 2 times faster than **Y** at the same temperature and pressure. Determine the;

(i) Empirical formula of **Y**. *(02 marks)*

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(ii) Molecular formular of **Y**. *(03 marks)*

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(b) Gas **Y** was bubbled into acidified potassium manganate (VII) solution.

(i) State what was observed. *(01 marks)*

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

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(c) Barium nitrate solution was added to the resultant solution in (b) above;

(i) State what was observed. *(01 marks)*

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(ii) Write an ionic equation for the reaction that took place. *(01 mark)*

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11. Name a reagent(s) which can be used to distinguish between the following compounds. State what would be observed if each member of the pair is treated with the reagent.

(a) $BaCl_{2(aq)}$ and $CaCl_{2(aq)}$ *(03 marks)*

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(b) CH_3CHO and $CH_3CH_2CH_2CHO$. *(03marks)*

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(c) $CH_3\overset{\overset{O}{\|}}{C}CH_3CH_2CH_3$ and $CH_3CH_2\overset{\overset{O}{\|}}{C}CH_2CH_3$ *(03 marks)*

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12. (a) (i) Write the name and formula of one ore from which aluminium is extracted. *(01 mark)*

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(ii) Name two impurities in the ore. *(01 mark)*

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(iii) Name a reagent used in the purification of the ore. *(½ mark)*

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(b) Write equation(s) for reactions(s) that take place during the purification of the ore. *(4½ marks)*

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(c) Cryolite is added to the melted ore and electrolysed;

(i) State the purpose of adding cryolite. *(½ marks)*

(d) Write an equation to show how anhydrous aluminium chloride can be prepared from aluminium oxide. *(1½ marks)*

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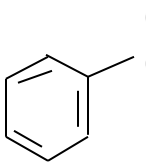
13. Complete the following equations and outline a mechanism for the reaction.

(a)  $\xrightarrow[\text{Conc. } H_2SO_4]{\text{conc.}HNO_3}$ *(04 marks)*

(b) $CH_3C{\equiv}CH \xrightarrow[CCl_4]{\text{excess HBr}}$ *(3½ marks)*

(c) $CH_3CH=CH_2 + HCl \xrightarrow{ROOR}$ *(1½ marks)*

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14. (a) Sodium benzoate undergoes hydrolysis when dissolved in water, write;

(i) An equation for the hydrolysis of sodium benzoate in water. *(01 mark)*

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(ii) The expression for the hydrolysis constant Ka for sodium benzoate. *(01 marks)*

(b) The hydrolysis constant K_h for sodium benzoate is 1.6×10^{-10} $moldm^{-3}$. Calculate the PH of a 0.1M sodium benzoate solution.

($Kw = 1.0 \times 10^{-14}\ mol^2\ dm^{-6}$) *(03 marks)*

(c) Calculate the mass of sodium benzoate that should be added to $1dm^3$ of 0.1M benzoic acid in order to give a solution whose pH is 4.6. *(04 marks)*

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15. (a) The initial rate of reaction between ester A and aqueous sodium hydroxide was measured in a series of experiments at a constant temperature. The data obtained are shown below.

Experiment	Initial concentration of NaOH / mol dm^{-3}	Initial concentration of **A** / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	0.040	0.030	4.0×10^{-4}
2	0.040	0.045	6.0×10^{-4}
3	0.060	0.045	9.0×10^{-4}
4	0.120	0.060	to be calculated

Use the data in the table to deduce the order of reaction with respect to **A** and the order of reaction with respect to NaOH. Hence calculate the initial rate of reaction in
Experiment 4.

Order with respect to
A**.....**

Order with respect to
NaOH.....

Initial rate in Experiment
4.....

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(b) In a further experiment at a different temperature, the initial rate of reaction was found to be 9.0×10^{-3} moldm^{-3} s^{-1} when the initial concentration of **A** was 0.020 moldm^{-3} and the initial concentration of NaOH was 2.00 moldm^{-3}. Under these new conditions with the much higher concentration of sodium hydroxide, the reaction is first order with respect to **A** and appears to be zero order with respect to sodium hydroxide.

(i) Write a rate equation for the reaction under these new conditions.

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(ii) Calculate a value for the rate constant under these new conditions and state its units.

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(iii) Suggest why the order of reaction with respect to sodium hydroxide appears to be zero under these new conditions.

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16. (a) Write the electronic configuration of chromium. *(½ mark)*

(b) A mixture of chromium (III) oxide and sodium peroxide was heated;

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

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

(c) Dilute hydrochloric acid was added to chromium (III) oxide.

(i) State what was observed. *(½ mark)*

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

(d) Sodium hydroxide solution was added drop wise until in excess to the resultant solution in (c) followed by hydrogen peroxide solution and the mixture heated.

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

(ii) Write equation(s) for the reaction(s) that took place. *(2½ marks)*

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17. (a) Methanol is manufactured by reacting carbon and hydrogen according to the equation;

$CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)} \quad \Delta H = -65 KJmol^{-1}$

State the conditions necessary for optimum yield of methanol. *(1½ marks)*

(c) Stoichiometric amounts of carbon monoxide and hydrogen were reacted. At equilibrium 15% of the carbon monoxide had reacted;

(i) Calculate the number of moles of carbon monoxide, hydrogen and methanol present at equilibrium. *(02½ marks)*

(ii) If the equilibrium constant for the reaction is 4×10^{-10} Pa^{-2}, the pressure in the system. *(05 marks)*

END