ELITE EXAMINATION BUREAU MOCK 2019
Uganda Advanced Certificate of Education
CHEMISTRY
Paper 2
2Hours 30Minutes

INSTRUCTIONS TO THE CANDIDATES:

- *Attempt **any five** questions including **three** questions from* Section **A** *and any* **two** *questions from* Section **B***.*
- *Mathematical tables and graph papers are provided.*
- *Non – programmable scientific calculators may be used.*
- *Use equation where necessary to illustrate your, answer.*

Where necessary, use the following values:

[C = 12, O = 16,H = 1]

Begin each question on a fresh page.

SECTION A

Answer **three** *questions from this section*

1.   (a)   Define the term **first electron affinity**.   (1 mark)

        (b)   The first electron affinities of group (VII) elements are given below:

Element	F	cl	Br	I
E.A $(KJmol^{-1})$	-328	-349	-325	-295

            (i)   Explain the trend of first electron affinities of the elements.

                                                              (3 marks)

            (ii)   Fluorine differs from the rest of the elements. State **three** other reasons for the anomalous behavior of fluorine.

                                                              (3marks)

        (c)   Describe the reactions of

            (i)   fluorine, chlorine and bromine with sodium hydroxide.   (6 marks)

            (ii)   hydrides of group (VII) elements with concentrated sulphuric acid.

                                                              (4 marks)

        (d)   A solution containing chlorate(V) ions and dilute sulphuric acid was added to a solution containing iodide ions. Explain what was observed.

                                                                (3 marks)

2.   A compound **Q** contains 76.32% carbon, 6.38% hydrogen and the rest being oxygen. A solution of **Q** in water is acidic but does not liberate carbon dioxide from carbonates. A solution of 1.50 g of **Q** in 20.90 g of benzene freezes at 1.3^0C while pure benzene freezes at 5.50^0C.

        (a)   Determine

            (i)   the empirical formula of **Q.**   (2 marks)

            (ii)   the molecular formula and write the structural formula of **Q**. *(Kf of benzene is 5.49^0C per 1000 g mol^{-1})*   (3 marks)

        (b)   Explain why a solution of **Q** in water is acidic.   (2 marks)

        (c)   Describe the reaction of **Q** with bromine water.   (2 ½ marks)

(d) Write equation and outline the mechanism for the reaction between **Q** and

    (i)   ethonylchloride   (3 marks)

    (ii)   chloromethane in presence of sodium hydroxide.
                                                             (2 marks)

(e) Write equations to show how **Q** can be
    (i)   prepared from benzene and propene.   (3 ½ marks)

    (ii)   converted to methylbenzene   (2 marks)

3. (a) Explain the terms:

    (i)   **Partition coefficient**   (2 marks)
    (ii)   **Solvent extraction**   (1 mark)

 (b) Describe an experiment to determine the partition coefficient for benzoic acid between water and benzene at room temperature.   (6 marks)

(c) In an experiment to find the partition coefficient of ammonia between water and carbon tetrachloride, $100cm^3$ of the aqueous layer required $13.2cm^3$ of 0.25**M** nitric acid for complete reaction. $25cm^3$ of organic layer required $6.6cm^3$ of 0.05**M** nitric acid. Calculate the partition coefficient of ammonia.   (5 marks)

(d) 2.5×10^{-2} $moldm^{-3}$ of zinc sulphate was allowed to reach equilibrium with excess ammonia and carbon tetrachloride. The aqueous layer was found to contain 0.4**M** ammonia and the organic layer had 0.012**M** ammonia. Using your answer in (c) above, determine the formula of a complex ion formed between ammonia and zinc ions.   (3marks)

(e) An aqueous solution containing 10.0gdm^{-3} of compound **E** was shaken with $500cm^3$ of ether. Calculate the mass of E that remains in water. *(K$_d$ of E between water and ether is 0.0111)*   (3 marks)

4. Explain the following observations.

(a) Oxygen and sulphur are in group (VI) of the Periodic Table. Oxygen is a gas but sulphur is a solid. (5 marks)

(b) Hydrated sodium carbonate dissolves in water endothermically while anhydrous sodium carbonate dissolves exothermically. (3 marks)

(c) The pH of water is 7.0 at 25^0C and 6.4 at 75^0C. (3 marks)

(d) Alkenes undergo electrophilic addition while carbonyl compounds undergo nucleophilic addition. (4 marks)

(e) When ammonia solution is added to aqueous manganese (II) sulphate, a white precipitate is formed but when ammonia solution is added to manganese (II) sulphate in the presence of ammonium chloride, there is no observable change. (5 marks)
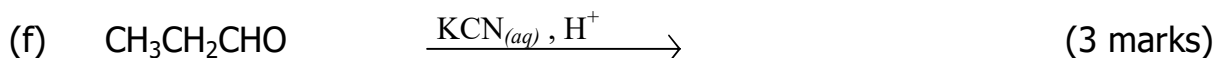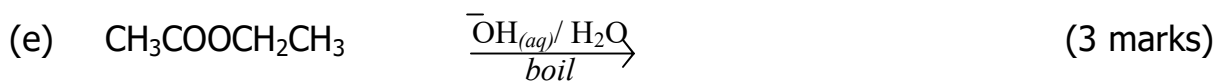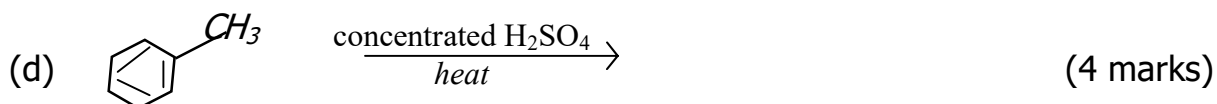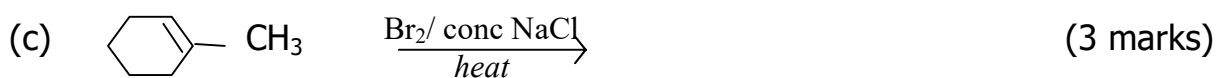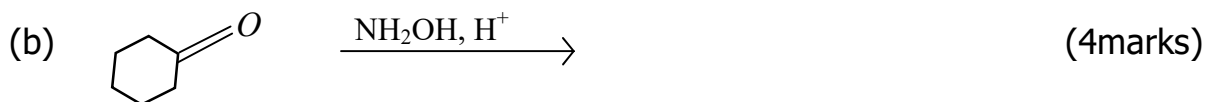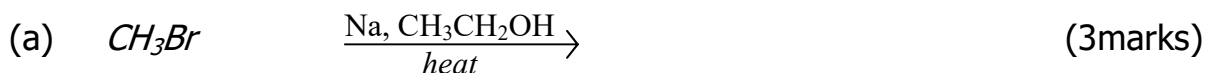
SECTION B

Answer **two** *questions only.*

5. The elements carbon, silicon, tin and lead are in group (IV) of the Periodic Table.

(a) Explain the trend in

(i) their metallic character (3 marks)

(ii) stability of the +2 oxidation state. (2½ marks)

(b) Carbon differs from other members of the group in some properties. State **two**
(i) reasons why carbon differs from other members of the group? (2marks)

(ii) properties that distinguish carbon from other members of the group. (2marks)

(c) Describe the reactions of lead(IV) oxide with

(i) hydrochloric acid (4 marks)

(ii) sodium hydroxide (2 ½ marks)

(d)   Write equation for the reaction between

(i)   silicon(IV) oxide and hydrofluoric acid
(ii)   tin(IV) chloride and water
(iii)   red lead oxide, Pb_3O_4 and dilute nitric acid   (4½ marks)

6.   Complete the following equations and outline the mechanisms for the reactions in each case.

(a) CH_3Br $\xrightarrow[\text{heat}]{\text{Na, CH}_3\text{CH}_2\text{OH}}$ (3marks)

(b) $\xrightarrow{\text{NH}_2\text{OH, H}^+}$ (4marks)

(c) CH_3 $\xrightarrow[\text{heat}]{\text{Br}_2/\text{ conc NaCl}}$ (3 marks)

(d) $\xrightarrow[\text{heat}]{\text{concentrated H}_2\text{SO}_4}$ (4 marks)

(e) $CH_3COOCH_2CH_3$ $\xrightarrow[\text{boil}]{\overline{\text{O}}\text{H}_{(aq)}/\text{ H}_2\text{O}}$ (3 marks)

(f) CH_3CH_2CHO $\xrightarrow{\text{KCN}_{(aq)}\text{ , H}^+}$ (3 marks)

7.   (a)   (i)   Distinguish between **electrolytic conductivity** and **molar conductivity** of a solution.   (2 marks)

        (ii)   Write the equation to show the relationship between electrolytic conductivity and molar conductivity of a solution.   (1 mark)

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(b) The table below gives the molar conductivity of a solution of ethanoic acid at 298 K.

[CH_3CO_2H] $(moldm^{-3})$	0.001	0.01	0.1
Molar conductivity $(\Omega^{-1}cm^2mol^{-1})$	50	16	5

(a) Give a reason for the decreasing values of molar conductivity of ethanoic acid with increase in concentration. (1mark)

(b) Calculate the pH and ionization constant, Ka of 0.01M ethanoic acid. *(The molar conductivity of ethanoic acid at infinite dilution is $390\Omega^{-1}$ cm^2mol^{-1}*

(c) (i) Define the term **standard electrode potential**. (1 mark)

(ii) Discuss the factors that affect the value of standard electrode potential. (4 marks)

(iii) State **two** applications of standard electrode potential. (2 marks)

(d) The standard electrode potentials of systems, $Pt_{(s)}$ | $H_{2(g)}$ | $HCl_{(aq)}$ || and $CuSO_{4(aq)}$ | $Cu_{(s)}$ are 0.00 V and +0.34 V respectively.

(i) Write equation for the overall cell reaction. (1½ marks)

(ii) Calculate the maximum energy obtained from the cell. (F = 96500 C) (2½ marks)

8. (a) Define the terms:
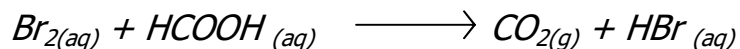
(i) **order of reaction** (1mark)

(ii) **rate constant** (1 mark)

(b) Propanone reacts with iodine according to the equation:

$$CH_3COCH_{3(aq)} + I_{2(aq)} \xrightleftharpoons{H^+_{(aq)}} CH_3COCH_2I_{(aq)} + HI_{(aq)}$$
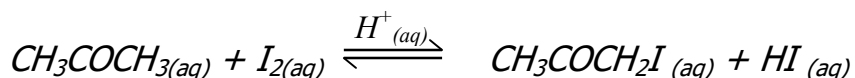
The reaction is first order with respect to propanone and zero order with respect to iodine. Describe an experiment that can be carried out to determine the order of reaction with respect to iodine. (6 marks)

(c) The kinetic table below was obtained for the oxidation of methanoic acid using bromine water.

$$Br_{2(aq)} + HCOOH_{(aq)} \longrightarrow CO_{2(g)} + HBr_{(aq)}$$

ln [Br$_2$]	0.22	0.04	-0.16	-0.33	-0.51	-0.70
Time / sec	10	20	30	40	50	60

(i) Plot a graph of ln[Br$_2$] against time. (3 marks)

(ii) Use the graph to determine the order of reaction. Give a reason for your answer. (2marks)

(iii) Find the original concentration of bromine solution. (1½ marks)

(iv) Calculate the rate constant. (1½ marks)

(d) The results for the hydrolysis of an iodoalkane, C_4H_9I with sodium hydroxide are shown below.

$[C_4H_9I]$ $moll^{-1}$	$[OH-]$ $moll^{-1}$	Rate $(moll^{-1s-1})$
0.05	0.10	1.00 x 10^{-3}
0.20	0.10	4.00 x 10^{-3}
0.20	0.05	4.00 x 10^{-3}

(i) Deduce the rate equation. (3 marks)

(ii) Identify the alkylhalide (1 mark)

END

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