Name ……..…….. Index No...……..…….

Candidate signature……... Date: ……..

233/2
CHEMISTRY
Paper 2 (THEORY)
July / August – 2018
Time: 2 Hours

INSTRUCTIONS TO CANDIDATES

- Write your name and index number in the spaces provided above.
- Sign and write the date of examination in the spaces provided.
- Answer **all** the questions in the spaces provided.
- KNEC mathematical tables and non-programmable electronic calculators may be used.
- All working **must** be clearly shown where necessary
- Candidates should check whether the question paper to ascertain that all the pages are printed and that no questions are missing.
- Candidates should answer the questions in **English**

FOR EXAMINER'S USE ONLY

Q	MARKS	CANDITATE SCORE
1	12	
2	9	
3	13	
4	11	
5	12	
6	12	
7	11	
TOTAL	80	

1. Use the information below on standard electrode potentials to answer the questions that follow

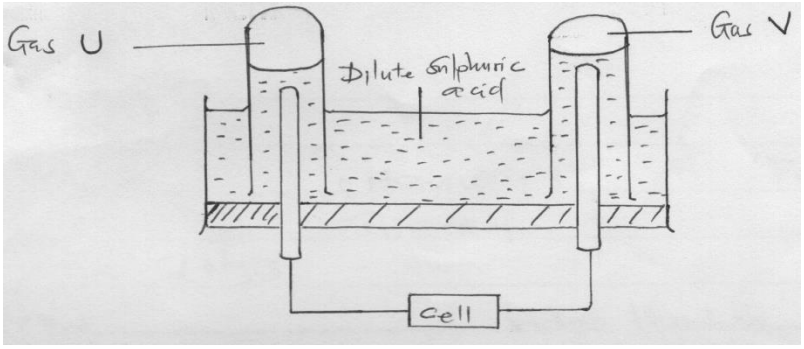
Electronic reaction		E^{Θ} volts
$C^{2+}_{(aq)} + 2e^-$	$C_{(s)}$	+0.34
$D^{2+}_{(aq)} + 2e^-$	$D_{(s)}$	+0.44
$E^{+}_{(aq)} + e^-$	$E_{(s)}$	-2.92
$F^{2+}_{(aq)} + 2e^-$	$F_{(s)}$	-2.71
$G^{2+}_{(aq)} + 2e^-$	$G_{(s)}$	-0.14
$\frac{1}{2}H_{2(g)} + e^-$	$H^-_{(aq)}$	+2.87
$\frac{1}{2}K_{2(g)} + e^-$	$K^-_{(aq)}$	+1.09
$L^{+}_{(aq)} + e^-$	$\frac{1}{2}L_{2(aq)}$	0.00

a) i) Identify the strongest reducing agent and oxidizing half cells. Give reasons (2mks)

ii) Calculate the emf of the cell obtained by connecting half cells **C** and **D** (1mk)

b) Draw a well labeled diagram of a cell formed by connecting half cells **E** and **D**. on the diagram indicate the flow of electrons (3mks)

c) The figure below shows the electrolysis of dilute sulphuric (VI) acid



i) On the diagram label the cathode and anode (1mk)

ii) Name the gases **U** and **V** (1mk)

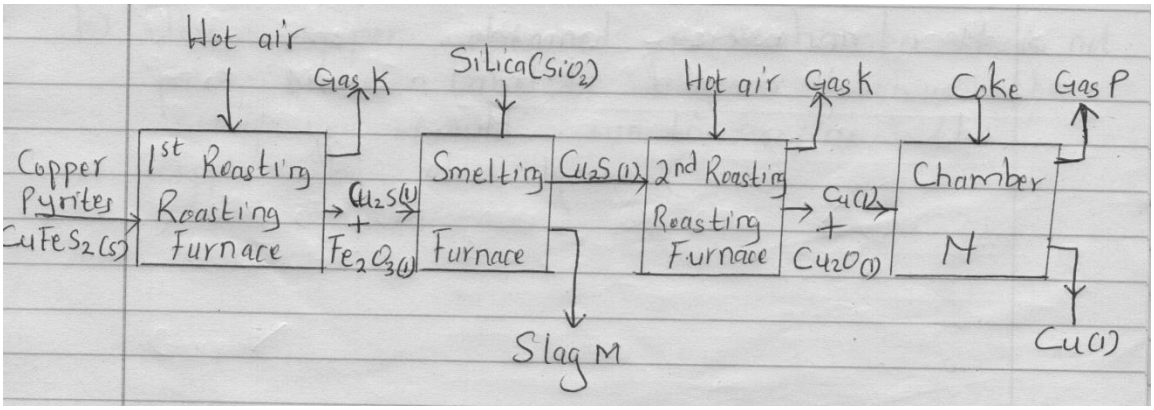
Gas **U**

Gas **V**

iii) Write the equation taking place at the anode (1mk)

d) Define electrolysis and state any **two** applications of electrolysis (3mks)

2. a) The flow chart below outlines some of the processes involved during extraction of copper from copper pyrites. Study it and answer the questions that follow.



i) Name gas K (1mk)

ii) Write an equation for the reaction that takes place in the 1st roasting furnace (1mk)

iii) Write the formula of the cation present in slag **M** (1mk)

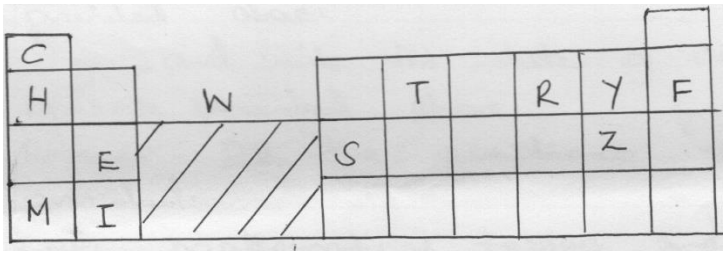
iv) Identify gas **P** (1mk)

v) What name is given to the reaction that takes place in chamber **N**? Give a reason for the answer (1mk)

b) The copper obtained from chamber **N** is not pure. Draw a labeled diagram to show the set up you would use to refine the copper by electrolysis (2mks)

c) Give two effects that this process could have on the environment (2mks)

3. a) The grid below represents part of the periodic table. Study the information and answer the questions that follow. The letters do not represent the actual symbol of the elements.



i) Which element would form a trivalent cation? (1mk)

ii) Write the equation for the reaction that would occur between **E** and **Y** (1mk)

iii) Which elements belong to the region labeled W? (1mk)

iv) Which is the most reactive non-metallic element in the table above? Explain (2mks)

v) How does the atomic radius of **T** compare with that of **Y** (2mks)

b) The table below shows some properties and electronic arrangements of common ions of elements represented by letters **D** to **K**. Study the information and answer the questions that follow>

Element	Formula of ion	Ionic electronic arrangement	Atomic radius (nm)	Ionic radius (nm)
D	D^-	2.8	0.072	0.136
E	E^+	2.8.8	0.231	0.133
F	F^{3+}	2.8	0.143	0.050
G	G^{2+}	2.8.8	0.133	0.074
H	H^{2+}	2.8	0.160	0.064
I	I^+	2.8	0.186	0.095
J	J^{3-}	2.8.8	0.110	0.190
K	K^-	2.8.8	0.099	0.181

i) State the atomic numbers of elements **F** and **G** (1mk)

F

G

ii) Select two metals that belong to period 3 (1mk)

iii) Element **I** reacts violently with water. Write the equation for the reaction. (1mk)

iv) Why is the ionic radius of **G** smaller than its atomic radius (1mk)

v) Compare and explain the reactivity of **G** and **H** (2mks)

4. In an experiment to study the rate of reaction between duralumin (an alloy of aluminum, magnesium and copper) and hydrochloric acid, **0.5 g** of the alloy were reacted with excess **4M** hydrochloric acid. The data in the table below was recorded. Use it to answer the questions that follow.

Time (minutes)	Total volume of gas (cm^3)
1	0
2	220
3	410
4	540
5	620
6	640
7	640

a) i) on the graph paper provided plot a graph of total volume of a gas produced against time (3mks)

ii) From the graph determine the volume of gas produced at the end of 2½ minutes (1mk)

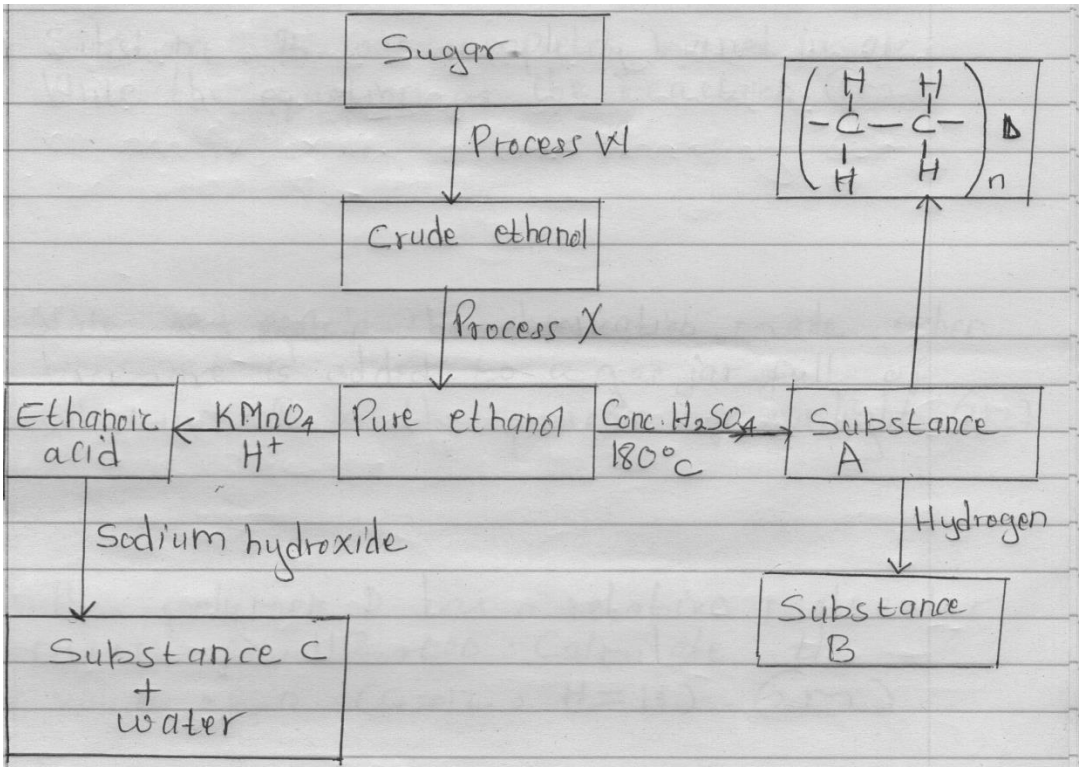
b) Determine the rate of reaction between the 3^{rd} and 4^{th} minute (1mk)

c) Give a reason why some solid remained at the end of the experiment (1mk)

d) Given that $2.5cm^3$ of the total volume of the gas was from the reaction between magnesium and aqueous hydrochloric acid, calculate the percentage mass of aluminium present in 0.5 g of the alloy. (Al = 27, and molar gas volume = $24000cm^3$ at 298K) (3mks)

e) State **two** properties of duralumin that makes it more suitable than aluminum in aero plane construction (2mks)

5. The flow chart below is for the manufacture of sodium carbonate using Solvay process. Use it to answer the questions that follow



a) Name :

i) Gas **W** (1mk)

ii) Solution **H** (1mk)

iii) Solid **X** (1mk)

iv) The product **J** (1mk)

b) Write an equation for the reaction in chamber B (1mk)

c) Name **two** raw materials used in Solvay process (2mks)

d) i) Name **one** substance recycled in Solvay process (1mk)

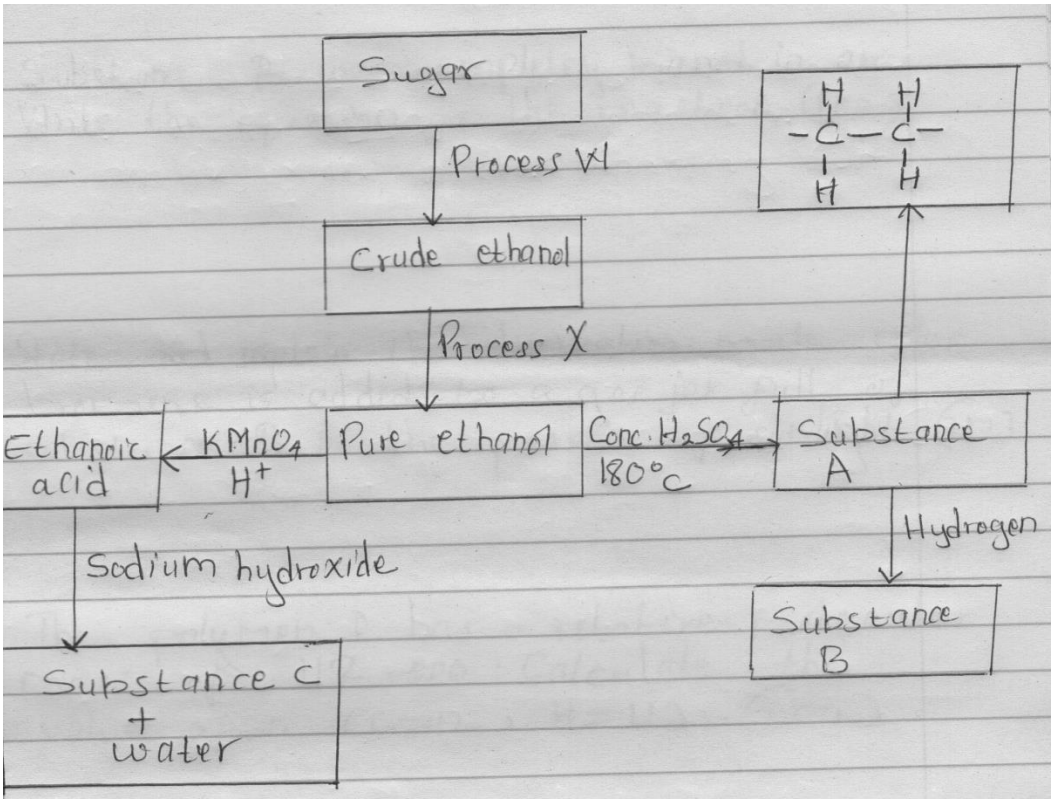
ii) Give **two** reasons why CO_2 is used as fire extinguisher (2mks)

iii) Explain why lead carbonate is not reacted with dilute H_2SO_4 in preparation of CO_2 in the laboratory (2mks)

6. a) Name four components of crude oil (2mks)

b) What is the difference between thermal cracking and catalytic cracking? (2mks)

c) Study the flow chart below and answer the questions that follow.



i) identify process **W** and **X** (1mk)

ii) Name substances **B** and **C** (1mks)

iii) Write the equation for the reaction leading to production of substance **A** (1mk)

iv) Substance **B** was completely burned in air. Write the equation for the reaction (1mk)

v) State and explain the observations made when bromine is added to a das jar full of substance **B** in the presence of sunlight. (2mks)

vi) The polymer **D** has a relative molecular mass of 112,000. Calculate the value of n (C=12, H = 1) (2mks)

7. a) What is meant by molar heat of combustion? (1mk)

b) State the Hess's law (1mk)

c) Use the following standard enthalpies of combustion of graphite, hydrogen and enthalpy of formation of propane.

$$\Delta H^{\Theta}_{C}\ \textbf{(Graphite) = -393kJ/mol}$$
$$\Delta H^{\Theta}_{C}\ (H_{2\,(g)})\ \textbf{= -286kJ/mol}$$
$$\Delta H^{\Theta}_{f}\ \textbf{(}C_3H_8\textbf{) = -104kJ/mol}$$

i) Write the equation for the formation of propane (1mk)

ii) Draw an energy cycle diagram that links the heat of formation of propane with its heat of combustion and the heats of combustion of graphite and hydrogen (3mks)

iii) Calculate the standard heat of combustion of propane (1mk)

iv) Other than the enthalpy of combustion, state one factor which should be considered when choosing a fuel (1mk)

v) The molar enthalpies of neutralization for dilute hydrochloric acid and dilute nitric (V) acid are -57.2kJ/mole while that of ethanoic acid is -55.2kJ/mol. Explain this observations. (2mks)