Name ………………………..………...… ………………..…….. Index No…………..….…

Class ………………………..…Adm……………………..Candidate's Signature ……..…………

233/2
CHEMISTRY
PAPER 2
JUNE
(THEORY)
TIME: 2 HOURS

KABARAK-SACHO-SUNSHINE JET EXAMINATION

KASSU – 2014

Kenya Certificate of Secondary Education (K.C.S.E)
233/2
CHEMISTRY
PAPER 2
(THEORY)
TIME: 2 HOURS

INSTRUCTIONS

a) Write your name and the Index Number in the spaces provided above.
b) Answer **ALL** the questions in the spaces provided after each question.
c) Use of Mathematical sets and electronic calculators may be used.
d) **All** working should be clearly shown.

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QUESTIONS	EXPECTED SCORE	CANDIDATES SCORE
1	08	
2	12	
3	09	
4	11	
5	12	
6	14	
7	14	
TOTAL	**80**	

1   a)   The electron arrangement of ions A^{3+} and B^{2-} are 2.8 and 2.8.8 respectively. Write down the electron arrangement of the elements A and B.   (2marks)

A……………………………………………………………………………………….

B ……………………………...

b)   Study the information in the table below and answer the questions that follow. The letters are not the actual symbols of the elements.

Element	Atomic number	Boiling point (ºC)
K	3	1333
L	13	2470
M	16	445
N	18	-186
P	19	774

Which element

(i)   Is a gas at room temperature? Explain, taking room temperature as 25ºC.   (1mark)

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(ii)   Does not form an oxide? Explain.   (1 mark)

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(iii)   Write down the equation for the reaction between elements K and M.   (1 mark)

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(iv)   What type of bond would exist in the compound formed when elements M and L react? Give a reason for your answer (1 mark)

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(v)   Select the most electropositive element. Explain.   (1 mark)

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(vi)   Why the boiling point of element L is higher than that of element K.   (1 mark)

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2.   (a)   The sketch below represents a graph obtained when zinc granules were reacted

with excess 0.2M Sulphuric (VI) acid in the presence of a catalyst in a conical flask placed on an electronic balance.
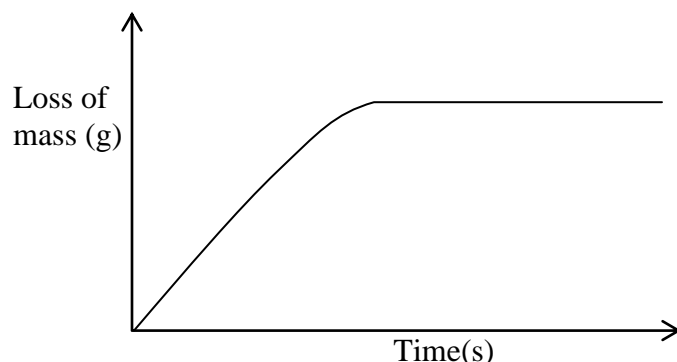
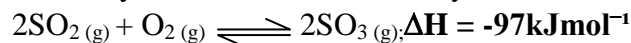(i)   Write an equation for the reaction that took place.   (1mark)

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(ii)   Explain why there is loss in mass.   (1mark)

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(iii) Name the catalyst used…………………………………………... (1mark)

(iv)   (a)   Sketch, on the same axes, the curves obtained when:
              I   the same mass of zinc powder was used under the same
                     conditions.   (1mark)
              II   no catalyst was used.   (1mark)

(b)   In the contact process, sulphur (IV) oxide is converted to Sulphur (VI) oxide in
       the catalytic chamber in which a dynamic chemical equilibrium is reached.
       $2SO_{2 (g)} + O_{2 (g)} \rightleftharpoons 2SO_{3 (g)};$**ΔH = -97kJmol⁻¹**
       (i)   What is meant by dynamic equilibrium?   (1mark)

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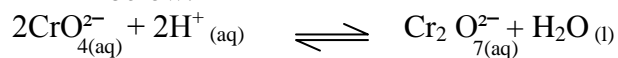
       ii)   State and explain how each of the following would affect the position of
              equilibrium.
              a) Decrease in temperature.   (2 marks)

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              b) Decrease in pressure.   (2 marks)

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(iii) Equilibrium exists between chromate and dichromate ions as shown below.

$$2CrO_4^{2-}{}_{(aq)} + 2H^+{}_{(aq)} \rightleftharpoons Cr_2O_7^{2-}{}_{(aq)} + H_2O_{(l)}$$

(Yellow)   *(Orange)*

State and explain the observation made when aqueous sodium hydroxide is added to the above mixture. (2 marks)

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3   a).   The table below shows the standard reduction potentials for four half–cells. Study it and answer the questions that follow (letter are not the actual symbols for the elements)

E^θ (Volts)

$F_{2(g)}$ +	2 e$^-$	$\longrightarrow$	$2F^-_{(aq)}$	+0.54
$G^{2+}_{(aq)}$ +	2e$^-$	$\longrightarrow$	$G_{(s)}$	-0.44
$H^{2+}_{(aq)}$ +	2e$^-$	$\longrightarrow$	$H_{(s)}$	+0.34
$2J^+_{(aq)}$ +	2e$^-$	$\longrightarrow$	$J_{2(g)}$	0.00

i) Identify the strongest reducing agents. ....…(1mark)

ii) Write the equation for the reaction which takes place when solid G is added to a solution containing H^{2+} ions. (1mark)

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iii) Calculate the E^0 value for the reaction in (ii) above. (1 mark)

b) The diagram below shows the apparatus that can be used to electrolyse acidified water to obtain hydrogen and oxygen gases. Study it and answer the questions that follow.
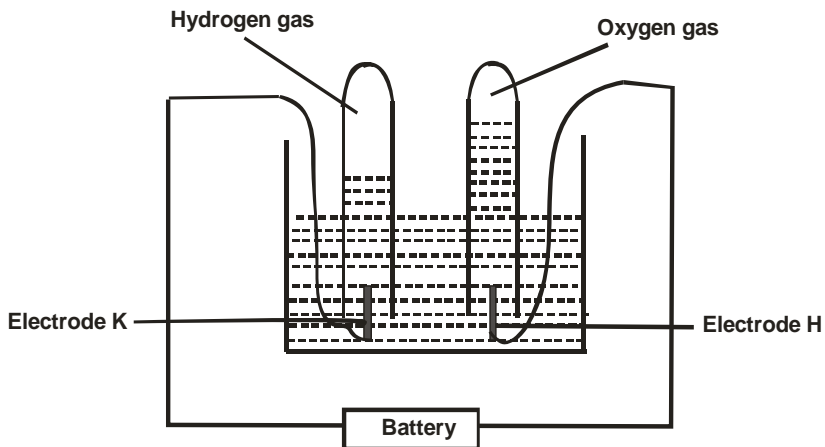
i. Identify the electrode at which oxidation takes place. (1 mark)

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ii. Give a reason why it is necessary to acidify the water. (1 mark)

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iii. Explain why hydrochloric acid is not used to acidify the water. (2 marks)

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c) During electrolysis of aqueous copper (II) sulphate 144750 C of electricity were used. Calculate the mass of copper metal that was obtained (Cu=64;1F =96500C)

(2 marks)

4. a) Describe how a sample of the solution could be tested to find out if it contained chloride ions. (2 marks)

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b) 20g of potassium chloride were placed in a glass beaker and 40.0cm^3 of water were added. The beaker was heated until all the potassium chloride had dissolved and then allowed to cool. When crystals first appear the temperature was noted.

An extra 5.0cm^3 of water were added and the experiment was repeated. The results of experiment were as shown below.

Experiment	Volume of water (cm^3)	Temperature at which crystals formed (^{0}C)	Solubility in g/100g of water
1	40	77	-
2	45	56	44.5
3	50	40	-
4	55	26	36.3
5	60	15	-
6	65	8	30.8

    I.   Calculate the values of solubility of KCl which are missing from the table (1$^1/_2$marks)

    II.   On the grid provided plot the graph of solubility against temperature (X-axis) (3 marks)
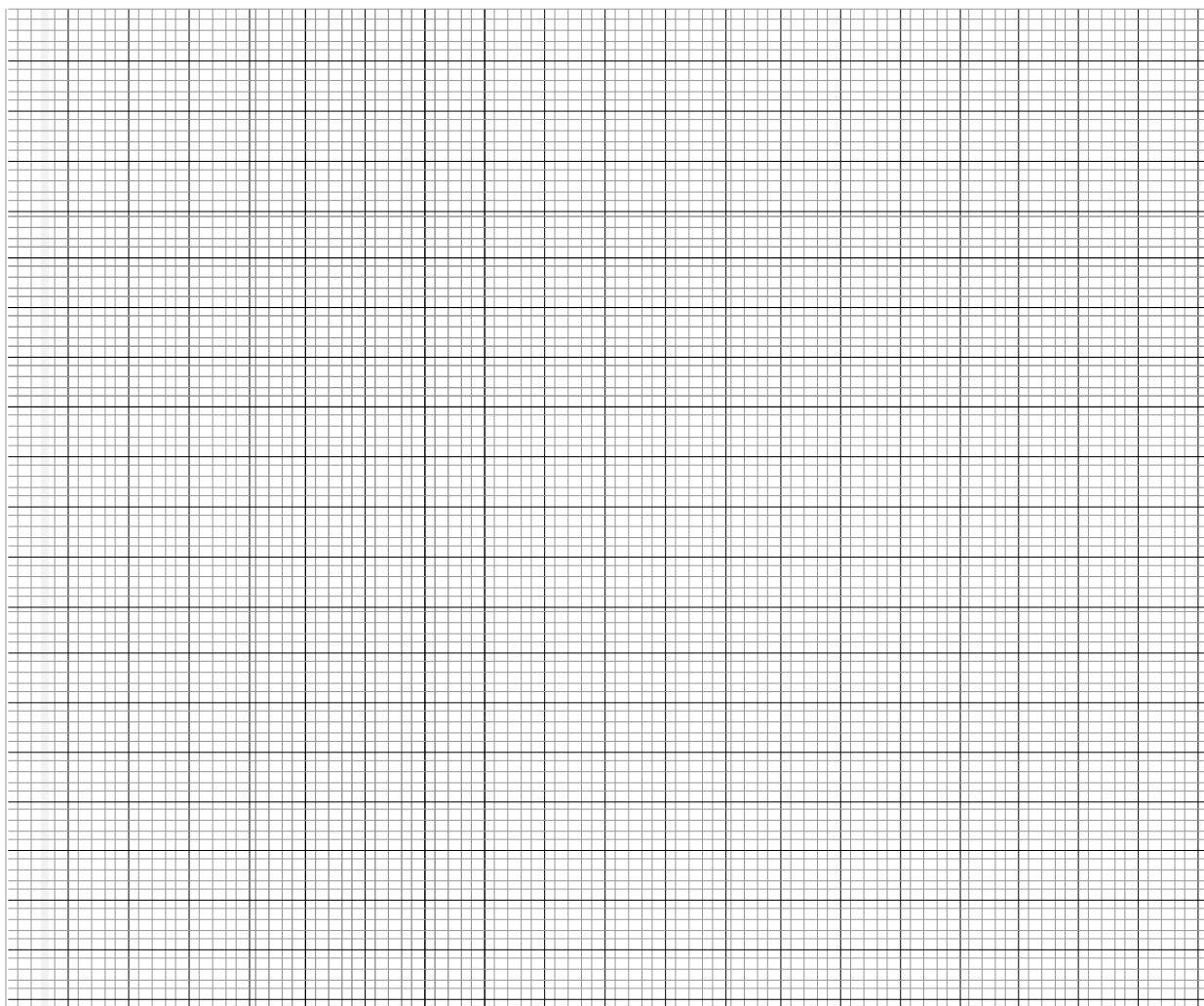
(i)   What is the effect of temperature on solubility of potassium chloride in water?   ($^1/_2$mark)

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(ii)   From the graph
    I.   What is the solubility of potassium chloride at 60^0C?   (1mark)

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    II.   At what temperature will solubility be 35g/100g of water?
                                                                                (1mark)

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    III.   What is the mass of crystals deposited when the solution is cooled from 70^0c to 40^0C?   (2marks)

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5   a)   Below is a simplified diagram of the Down's cell used for the manufacture of sodium. Study it and answer the questions that follow.

Hole through which NaCl Is added

Chlorine

sodium

Molten sodium chloride

Circular steel cathode

Circular steel cathode
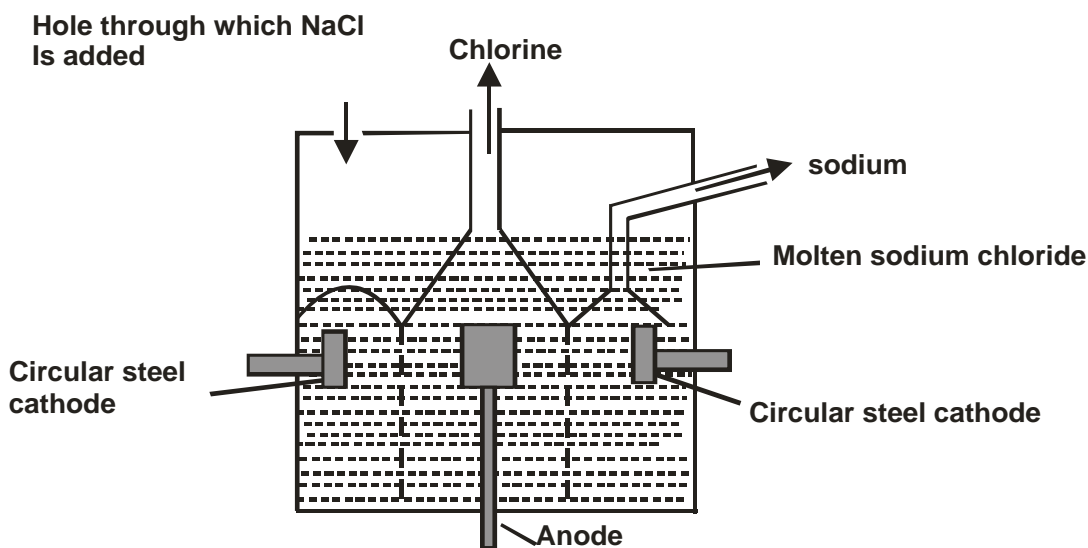
Anode

    i)   What material is the anode made of? Give a reason   (2 marks)

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    ii)   What precautions are taken to prevent chlorine and sodium from re-combining?   (1 mark)

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    iii)   Write an ionic equation for the reaction in which chlorine gas is formed.

                (1 mark)

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b).   In the Downs process above a certain salt is added to lower the melting point of sodium chloride from about 800^0c to about 600^0c.

    i).   Name the salt that is added.   (1 mark)

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    ii).   State why it is necessary to lower the temperature.   (1 mark)

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c).   Explain why aqueous sodium chloride is not suitable as an electrolyte for the manufacture of sodium in the Downs process.   (2 marks)

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d).   Sodium metal reacts with air to form two oxides. Give the formulae of the oxides.

                (1 mark)

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e).   In the space below draw a well labled diagram that can be used to extract zinc metal by electrolysis.   (2 marks)

6).   Study the structural formula below and answer the questions that follow.

    I. $CH_3\ CH_2\ COOH$

II $CH_3 CH_2 CH_2CH_2$ OH

(a)   (i)   Give the systematic name of each compound.   (1 mark)

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(ii)   Write the molecular formula of each compound.   (1 mark)

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(iii)   How does the boiling point of I compare to that of II? Explain.
                                                                (2 marks)

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(iv).   A gas J is bubbled into concentrated Sulphuric (VI) acid. Water is added
to the mixture then boiled to yield compound II. Name gas J. (1mark)

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(v)   Draw the structural formula of the compound immediately after compound
I in the homologous series.   (1 mark)

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(b)   Study the structural formula of the two monomers below and answer the questions
that follow.

O   O   H   H

|| || | |

C —— $(CH_2)4$ —— C   and   N – $(CH_2)_6$——N

| | | |

OH   OH   H   H
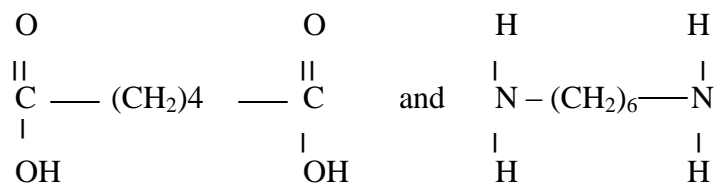
(i)   Name the type of polymerization these monomers would undergo to form
a polymer.   (1 mark)

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(ii)   Draw the structural formula to represent the polymer formed. (1 mark)

(iii)   What is the name of the polymer?   (1 mark)

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(iv)   State the use of this polymer.   (1 mark)

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(c)   Two cleansing agents are represented below.

wwww — COO^-Na^+ wwww — $OSO^-_3Na^+$
    Detergent P   ***Detergent R***
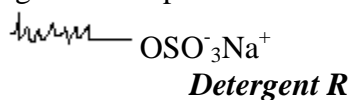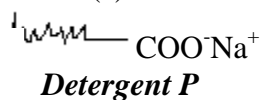
Select one of the detergents that would be suitable for washing in water
containing magnessium chloride. Explain.   (1 mark)

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d).   A factory produces 63.6 tonnes of anhydrous Na_2CO_3 on a certain day by Solvay
process. Calculate the number of tonnes of sodium chloride used on this particular
day. Assume the plant is working at 100% efficiency.
($C = 12$, $H = 1$, $Cl = 35.5$, $Ca = 40$, $Na = 23$)   (3 marks)

7.   In an experiment to determine the molar heat of neutralization of hydrochloric acid with
sodium hydroride, students of KASSU Secondary school reacted $100cm^3$ of 1M

hydrochloric acid with 50cm^3 of 2M sodium hydroxide solution. They obtained the following results.

Initial temperature of acid = 25.0^{0}C

Initial temperature of base = 25.0^{0}C

Highest temperature reached

With the acid – alkali mixture = 34.0^{0}C

(a)   Define the term molar heat of neutralization.   (1 mark)

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(b)   Write an ionic equation for the neutralization reaction between hydrochloric acid and sodium hydroxide.   (1 mark)

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(c)   **Calculate:**

(i)   The amount of heat produced during the reaction.

(S.h.c. of solution = 4.2 kJkg^{-1}k^{-1})   (3 marks)

(ii)   The molar heat of neutralization of sodium hydroxide.   (1 mark)

(iii)   Explain why molar heat of neutralization of IM NaOH is higher than that of 1M NH$_4$OH when reacted with 1M HCl.   (2 marks)

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(d)   Write the thermochemical equation for the reaction.   (1 mark)

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(e)   Draw an energy level diagram for the reaction.   (2 marks)

f)   Below are the heats of combustion of carbon, hydrogen gas and ethanol.

ΔHc $_{(carbon)}$ ΔH = -393 kJ/mol

ΔHc $_{(Hydrogen)}$ ΔH = -268 kJ/mol

ΔHc $_{(Ethanol)}$ ΔH = -1368 kJ/mol

Calculate the heat of formation of ethanol.   (3 marks)

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