Name _____ Index No. _____

Candidate's signature _____

Date _____

233/1
CHEMISTRY
PAPER 1
THEORY
JULY 2011
2 HRS

MAKINDU DISTRICT INTER-SECONDARY SCHOOLS EXAMINATION
PRE - Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 1
2 HRS

INSTRUCTIONS TO CANDIDATES

(a) Write your name and index number in the spaces provided above .
(b) Sign and write the date of examination in the spaces provided above.
(c) Answer ALL the questions in the spaces provided.
(d) Mathematical tables and silent calculators may be used.
(e) All working MUST be clearly shown where necessary
(f) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.
(h) This paper consists of 12 printed pages

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Questions	Maximum Score	Candidate's Score
1 – 29	80	

This paper consists of 12 printed pages

Turn Over

1. In a sample, the percentage of $^{69}_{31}X$ is 60% and $^{71}_{31}X$ is 406.

(a) Calculate the R.A.M of X. (1 mark)

(b) Explain why the two isotopes of X have the same chemical properties. (1 mark)

_____

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2. In an experiment, ammonium chloride was heated in a test tube. A moist red litmus paper placed at the mouth of the test tube first changed blue then red. Explain these observations. (3 marks)

_____

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3. Classify the following processes as either chemical or physical (1 mark)

Process	Type of change
(a) Obtaining oil from plants	
(b) Tin plating	

4. An isotope of Uranium $\left(^{238}_{92}U\right)$ decays by emission of an alpha particle to form thorium $\left(^{234}_{90}Th\right)$

(a) Write the equation for the nuclear reaction that Uranium isotope undergoes. (1 mark)

_____

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_____

(b) State briefly how nuclear reactions differ from chemical reactions. (2 marks)

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5. When a hydrocarbon was completely burnt in oxygen, 4.2g of carbon (IV) oxide and 1.71g of water were formed. Determine the empirical formula of the hydrocarbon (H = 1.0, C = 12.0, O = 16.0) (3 marks)

6. From the heat of combustion of the following :
Calculate the heat of formation of ethanol ΔHf^{θ} (C_2H_5OH) (3 marks)

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\Delta H_C = -393 kJmol^{-1}$

$H_{2(g)} + O_{2(g)} \longrightarrow H_2O_{(l)}$ $\Delta H_C = -286 kJmol^{-1}$

$CH_3CH_2OH_{(l)} + O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)} = -1368 kJmol^{-1}$

7. The electron affinities for three elements E, F and G are shown in the table below.

Element	E	F	G
Electron affinity kJ/mol	-652	-364	-270

(a) What is meant by electron affinity? (1 mark)

_____

_____

_____

_____

(b) Which element is the strongest oxidizing agent. Explain. (2 marks)

_____

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8. The body of a ship is painted to prevent rusting.

(i) How does paint stop rusting? (1 mark)

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(ii) Blocks of zinc are attached to the hull of a ship to prevent rusting. Explain. (1 mark)

_____

_____

_____

_____

(iii) Why might a ship in a sea-water rust faster than one that is only used in a fresh water lake ? (1 mark)

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9. What mass of silver would be coated on the cathode from a solution of silver nitrate by a current of 1 amp flowing for 30 minutes? (3 marks)

(Ag = 108, Faraday constant = 96500C mol^{-1})

10. (a) In Japan 2011, Fukushima nuclear reactor shaken by an earthquake and people were moved up to 30km radius. Give one effect this might have caused the people before they were evacuated. (1 mark)

(b) How was this Fukushima nuclear reactor benefiting the Japanese ? (1 mark)

11. The equation below represents the reaction between calcium carbonate and dilute hydrochloric acid.

$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

(a) What observation would be made when dilute hydrochloric acid is added to calcium carbonate ? (1 mark)

(b) 2.0g of calcium carbonate was added to dilute hydrochloric acid. What volume of carbon (IV) oxide would be given out at s.t.p ?
(Molar volume = $22.4dm^3$ at s.t.p) (2 marks)

12. The diagram below is a set-up for laboratory preparation of oxygen gas.

(a) Name solid K _____

(b) Write an equation for the reaction that takes place in the flask. (1 mark)

_____

_____

_____

(c) State one commercial use of oxygen. (1 mark)

_____

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_____

13. (a) State Graham's law of diffusion. (1 mark)

_____

_____

_____

(b) Explain how the rate of diffusion for same quantity of chlorine gas and oxygen gas compare under the same conditions of temperature and pressure
(Cl = 35.5, O = 16) (1 mark)

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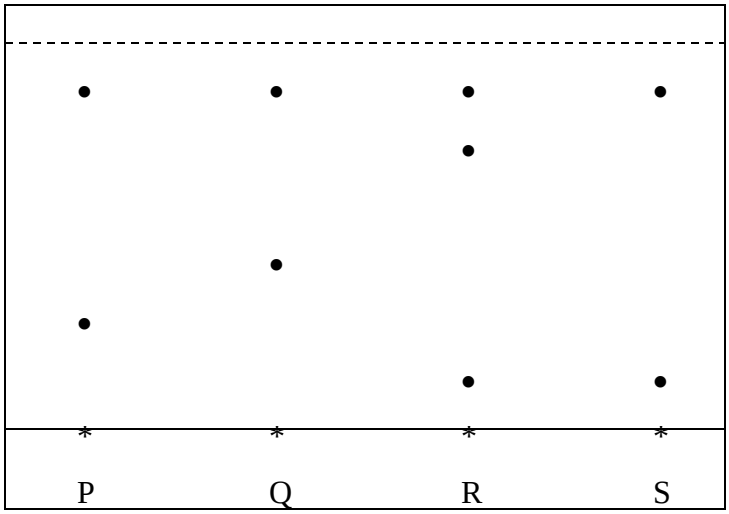
14. The paper chromatography below represents blood samples of four athletees, P, Q, R and S suspected to contain prohibited drugs. The results showed that the prohibited drugs were found in P, Q and R.



(a) Circle the spots which show the prohibited drugs. (1 mark)

(b) State two industrial application of chromatography. (2 marks)

_____

_____

_____

_____

15. (a)Give two cations that cause hardness in water. (1 mark)

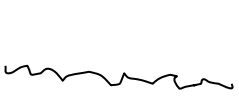
_____

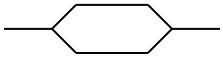
_____

_____

_____

(b) Identify the following cleaning agents. (1 mark)

(i)  _____

(ii) $CH_3CH_2CH_2$  OSO_3Na

_____

(iii) State one advantage of using the cleaning agent in b(ii) above. (1 mark)

_____

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_____

16. A compound W was heated and the following observations were made.

A glowing splint rekindled
A brown gas was given off
A yellow solid residue which later became white

(a) Identify (2 marks)

(i) Compound W _____

(ii) Solid residue _____

17. Use the information given below to answer the questions that follow.

Solution	pH
S	1.5
T	7.0
V	9.7

Which of the above solutions will not affect the colour of blue litmus paper? Explain. (3 marks)

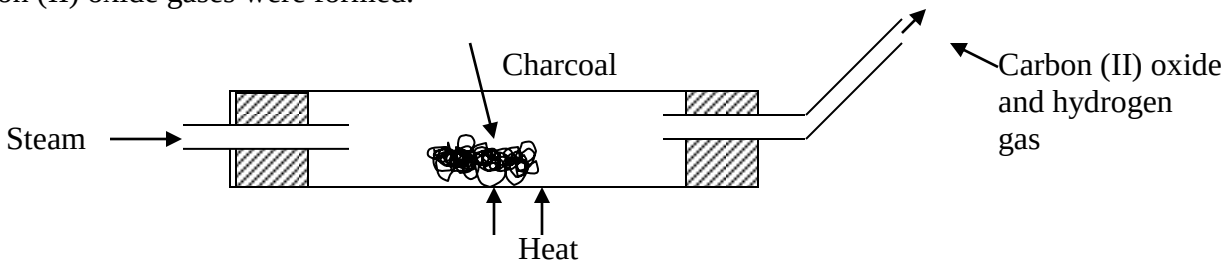
_____

_____

_____

_____

18. When steam was passed over heated charcoal in the diagram below, hydrogen and carbon (II) oxide gases were formed.



(a) Write down the equation for the reaction that took place. (1 mark)

_____

_____

_____

_____

(b) Name two common uses for both carbon (II) oxide and hydrogen gas. (2 marks)

_____

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_____

19. (a) Chlorine gas is bubbled through aqueous potassium iodide. (1 mark)

State the observation

_____

_____

_____

_____

Name the compound formed.

_____

_____

_____

(b) When chlorine water is left under sun light its bleaching property is lost. Explain. (2 marks)

_____

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20. (a) Define oxidation and reduction in terms of oxidation numbers . (1 mark)

_____

_____

_____

_____

(b) In the equation below, work out the oxidation number of chromium in $Cr_2O_7^{2-}$. (2 marks)

$28H^+_{(aq)} + 2Cr_2O_7^{2-}{}_{(aq)} + 12e^- \longrightarrow 4Cr^{3+}_{(aq)} + 14H_2O_{(l)}$

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21. Calculate the number of hydroxide ions (OH^-) present in $5cm^3$ of 0.25M calcium hydroxide solution. L = 6 x 10 (3 marks)

22. (a) Distinguish between a covalent bond and a co-ordinate bond. (2 marks)

_____

_____

_____

_____

(b) Using cross (x) and dot (.), draw a diagram to show bonding in hydroxonium ions (H= 1, O = 16)

23. State any two differences between luminous and non-luminous flames. (1 marks

Luminous flame	Non-luminous flame
1. _____	1. _____
_____	_____
2. _____	2. _____
_____	_____

24. Starting with nitric (V) acid, distilled water, lead (II) carbonate and sodium sulphate crystals, describe how you can prepare lead (II) sulphate crystals. (3 marks)

_____

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_____

25. For the reaction

$Cl_{2(g)} + 2I^-_{(aq)} \rightleftharpoons 2Cl^-_{(aq)} + I_{2(s)}$

Which species has been (2 marks)

(i) Oxidised ? _____

(ii) Reduced ? _____

26. Study the following equilibrium equation

$2D_{2(g)} + E_{2(g)} \rightleftharpoons 2D_2E_{(g)} \quad \Delta H = -197\ kJmol^{-1}$

(i) Suggest two ways of increasing the yield of D_2E. (1 mark)

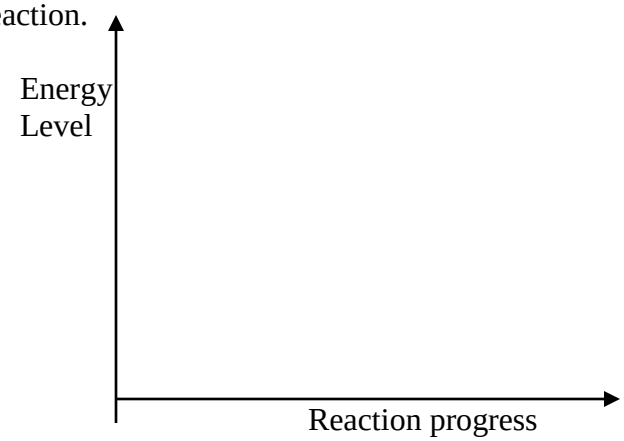
_____

_____

_____

_____

(ii) On the grid provided below draw a well labelled energy level diagram for the forward reaction. (2 marks)



27. Copper is extracted from its ores by a process of froth flotation and then roasted in air to produce copper (II) sulphide.

(a) What is froth flotation. (1 mark)

_____

_____

_____

_____

(b) State two properties of duralumin that makes it more suitable than pure aluminium in aeroplane construction. (2 marks)

_____

_____

_____

_____

28. Study the set-up below and answer the questions that follow.

Connecting wire Switch Anode Molten zinc chloride Crucible Heat Cathode

State and explain the observation that would be made if the circuit is completed. (3 marks)

_____

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29. $24.6cm^3$ of a solution of 0.12M potassium hydroxide were exactly neutralized by $28cm^3$ of a solution of sulphuric VI acid. Find the molarity of the acid. (3 marks)

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PAPER 1

MARKING SCHEME

1. (a) $\frac{(69 \times 60)}{100} + \frac{(71 \times 40)}{100} = (41.4 + 28.4) = 69.8$ √2

   (b) Have the same number of electrons in their outer energy levels. √1

2. NH_4Cl decomposes to form $NH_{3(g)}$ and $HCl_{(g)}$ √1. Ammonia diffuses faster than HCl because its lighter ammonia is basic and thus red litmus paper turns blue √1; while HCl is acid thus blue litmus turns red √1

. 3. (a) Physical
   (b) Chemical

4. (a) $^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He^{2+}$ √1

   (b) - Nuclear reactions are not affected by temperature, pressure or catalysts. √1
   - Nuclear reactions involve changes in the nucleus of an atom while chemical reactions involve changes in electrons in the outer energy levels √1

5.

Products	CO_2	H_2O
Formula mass	44	18
No. of moles	$\frac{\text{mass}}{\text{RFM}}$	$\frac{\text{mass}}{\text{RFM}}$ √ ½
	$\frac{4.2}{44}$	$\frac{1.71}{18}$
	0.095	0.095 √ ½
Mole ratio	1	: 1

The mass of carbon and hydrogen in CO_2 and H_2O formed

Products: carbon (CO_2) hydrogen (H_2O)

$\frac{12}{44} \times 4.2$ √ ½ $\frac{2}{18} \times 1.71$ √ ½

1.145 0.19

No. of moles $\frac{1.145}{12} = 0.095$ $\frac{0.19}{1} = 0.19$

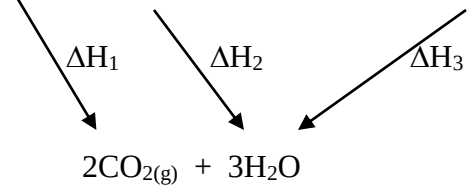
Mole ratio $\frac{0.095}{0.095} = 1$ $\frac{0.19}{0.095} = 2$

The empirical formula is CH_2 √1

This paper consists of 5 printed pages

Turn Over

6. $2C_{(s)} + 3H_{2(g)} \longrightarrow CH_3CH_2OH$



$2CO_{2(g)} + 3H_2O$

$\Delta Hf - \Delta H_3 \longrightarrow \Delta H_1 + \Delta H_2$

$\Delta Hf - 1368kJ = 2(-393) + 3(-286)$

$\Delta Hf = 1368 - 786 - 858$

$= 1368 - 1644$

$= -276\ kJmol^{-1}$

7. (a) Electron affinity is the energy released when an electron is added to a neutral atom.

(b) - E

- Releases the highest energy after gaining the electron

8. (i) Paint keeps off oxygen and water which are necessary for rusting √1

(ii) Zinc is more reactive than iron (used to make the hull of the ship) so oxygen and water react with zinc rather than iron. This is called sacrificial protection. √1

(iii) Salt in sea water catalyses the rusting process √1

9. $AgNO_{3(aq)}$, cathode $Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$ √1

Q = It √ ½

= 1 x 30 x 60

= 1800C √ ½

1 mol of electrons carry a charge of 96500C and deposit 108g

96500C = 108g

1800C = ?

$\frac{1800}{96500}$ x 108g √ ½

= 2.0145g √ ½

10. (a) -Damage to body of human

- Pollution of water with radioactive particles
- Weakening of structures
- Any other relevant answer

(b) - Electricity

11. (a) Effervescence or bubbles of a colourless gas occurs √ ½

(b) R.F.M of $CaCO_3$ = (40 x 1) + (12 x 1) + (3 x 16)

= 20 + 12 + 48 = 100 √ ½

1 mole of $CaCO_3$ = 100g

x moles of $CaCO_3 = \frac{1 \times 2.0}{100}$

= 0.02 moles √1

Mole ratio of $CaCO_3 : CO_2$ is 1 : 1

Therefore, 0.02 moles of CO_2 is evolved

1 mole of CO_2 at s.t.p = $22.4dm^3$
0.02 moles of CO_2 = y

$$y = \frac{0.02 \times 22.4}{1} = 0.048dm^3$$

$\therefore$ $0448dm^3$ or $448cm^3$ of CO_2 gas is produced √1

12. (a) Manganese (IV) oxide √1

(b) $2H_2O_{2(l)} \longrightarrow O_{2(g)} + 2H_2O_{(l)}$ √1

(c) - Welding
- Fuel in rockets
- Breathing aid / hospitals
- Steel making

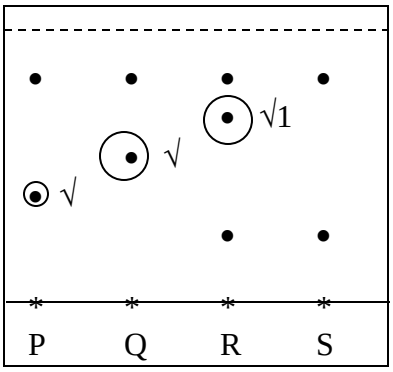
} Any one

13. (a) Graham's law of diffusion states that "the rate of diffusion of a gas is inversely proportional to the square root of its density, at constant temp and pressure."

(b) Cl_2 molecule = 71
O_2 molecule = 32
Ratio $Cl_2 : O_2$
71 : 32

$Cl_2 : O_2$
2.2 : 1
O_2 gas diffuses more than twice the rate at which Cl_2 gas diffuses

14. (a)



(b) - In pharmaceutical industry, to test purity of drugs
- In food industry, to identify contaminants in food and drinks
- In cosmetic industry, to identify harmful substances

Any two √1

15. (a) (i) Ca^{2+} ions
(ii) Mg^{2+} ions

(b) (i) Soap
(ii) Soapless detergent
(iii) - Does not form scum with hard water (due to formation of soluble salts)
- More soluble in water

16. (a) (i) W – $Zn(NO_3)_2$ or Zinc II nitrate
(ii) Residue ZnO or Zinc II oxide

17. - T and V √2
- pH of T shows it is neutral while that of V shows it is alkaline √1

18. (a) $H_2O_{(g)} + C_{(g)} \longrightarrow CO_{(g)} + H_{2(g)}$ √1

(b) - Reducing agents
- Fuel / methanol
- Synthetic petrol Any two √2

19. (a) Observation – Brown solution formed
Compound – $I_{2(aq)}$ molecules

(b) Chlorine water contains unstable chloric I acid which is decomposed by light to produce atomic oxygen √
Reactive – Atomic (nascent) oxygen causes bleaching but under light combine to form stable oxygen molecules.

20. (a) Oxidation – increase in oxidation number
Reduction is decrease in oxidation number

(b) $2x + (7x -2) = -2$ | $2x = 12$
$2x + -14 = -2$ | $x = 6$
$2x = 14 – 2$ |

21. 0.25 moles $(Ca(OH)_2$ in $1000cm^3$ solution
? moles $(Ca(OH)_2$ in $5cm^3$ solution
$\longrightarrow \frac{5 \times 0.25}{1000}$
$\longrightarrow$ 0.00125 moles $(Ca(OH)_2$

1 $Ca(OH)_2$ produces 2 OH- ions
7.5×10^{20} $Ca(OH)_2$ produces ? ions
$\longrightarrow \frac{7.5 \times 10^{20} \times 2}{1}$ √
$\longrightarrow 1.5 \times 10^{21}$ OH^- ions

22. (a) A covalent bond is formed by equal contribution of the shared electrons by the atoms √1; co-ordinate bond is where the shared electrons are contributed by one atom √1

(b) H H^+ H or $H^+ \leftarrow O(H) - H$ or H^+ x O (xx) x H (xo) o √1

23.

1. Luminous flame	Non- luminous flame
1. Large and wavy	1. Short and steady
2. Produces soot	2. Does not produce soot
3. Burns quietly	3. Burns with a roaring noise
4. Fairly hot	4. Very hot

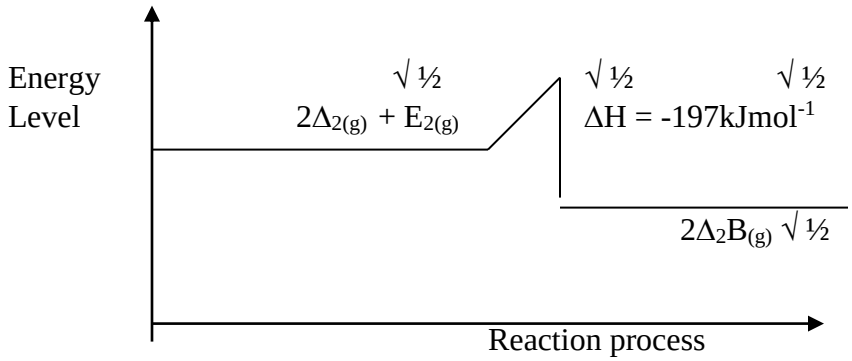
24. - Add small portions of lead (II) carbonate to nitric (V) acid in a beaker until some remain unreacted Lead (II) nitrate is formed. Filter the mixture to obtain the filtrate $Pb(NO_3)_2$
- Add distilled water to sodium sulphate to form a solution

- Mix the two solutions to obtain lead (II) sulpahte as precipitate.
- Filter the mixture to obtain lead (II) sulphate crystals as residue

25. $2I^-_{(aq)}$ - Oxidised √1
$Cl_{2(g)}$ -Reduced √1

26. (a) (i) - Decreasing the temperature since the reaction is exothermic
- Increasing pressure

(ii)



27. (a) Process of mixing the finely powdered ore with water and little oil and blowing air through the mixture in a tank. Froth carrying the ore float and can be tapped.

(b) - Stronger / higher tensile strength
- Harder / tougher
- More resistant to corrosion / durable Any 2

28. - Pale green gas bubbles are formed at the anode √1
The gas is chlorine
Chlorine ions move to the anode and give up electrons
Chlorine atoms are formed and then the atoms combine to make chlorine gas molecules as follows:

$Cl^-_{(l)} \longrightarrow Cl_{(g)} + e^-$; $Cl_{(g)} + Cl_{(g)} \longrightarrow Cl_{2(g)}$ √1

- Beads of grey molten zinc begin to collect at the cathode.
The zinc (Zn^{2+}) ion move to the cathode. They accept two electrons and becomes zinc atoms

$Zn^{2+}_{(l)} + 2e^- \longrightarrow Zn_{(l)}$ √1

29. Moles of KOH used
0.12 moles KOH is $1000cm^3$ solution
? $24.6cm^3$ solution

$$\frac{24.6 \times 0.12}{1000} = 2.952 \times 10^{-3} \text{ moles } \surd$$

$2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$

Moles H_2SO_4 in $28cm^3$
2 : 1

$2.952 \times 10^{-3} : ? \longrightarrow \frac{2.952 \times 10^{-3} \times 1}{2}$

$\longrightarrow = 1.476 \times 10^{-3}$ moles √

Name _____ Index No. _____

Candidate's signature _____

Date _____

233/2
CHEMISTRY
PAPER 2
THEORY
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MAKINDU DISTRICT INTER-SECONDARY SCHOOLS EXAMINATION
PRE - Kenya Certificate of Secondary Education
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INSTRUCTIONS TO CANDIDATES

(a) Write your name and index number in the spaces provided above .
(b) Sign and write the date of examination in the spaces provided above.
(c) Answer ALL the questions in the spaces provided.
(d) Mathematical tables and silent calculators may be used.
(e) All working MUST be clearly shown where necessary
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Questions	Maximum Score	Candidate's Score
1	12	
2 - 7	12	
3	12	
4	12	
5	12	
6	10	
7	10	
Total Score	80	

This paper consists of 13 printed pages

Turn Over

1.

				A				
	B		C			D	E	
	F						G	

(a) Name the family of elements to which the following elements belong to
B and F (1 mark)

_____

_____

_____

(b) Write an equation for the reaction between element C and chlorine. (1 mark)

_____

_____

_____

(c) Compare the reactivity of E and G. Give a reason for your answer. (2 marks)

_____

_____

_____

_____

(d) Compare the atomic radius of B and E. Explain. (2 marks)

_____

_____

_____

_____

(e) Write down the electronic configuration of the ion of D. (1 mark)

_____

_____

(f) Study the table below and answer the questions that follow.

Chloride	NaCl	$AlCl_3$	S_2Cl_4	PCl_3
M.P ^0C	80l	Sublimes at 180^0C	-70	-90
Oxide	Na_2O	Al_2O_3	SiO_2	P_4O_{10}
M.P ^0C	1190	2050	1730	560
Nature of oxide in water	Alkaline			Acidic

(i) Explain the differences in the melting point of $SiCl_4$ and SiO_2. (2 marks)

_____

_____

_____

_____

(ii) Why is the nature of solution of Al_2O_3 and SiO_2 not indicated in the above table. (1 mark)

_____

_____

_____

_____

(iii) Aqueous solution of PCl_3 is acidic while NaCl is neutral. Explain. (2 marks)

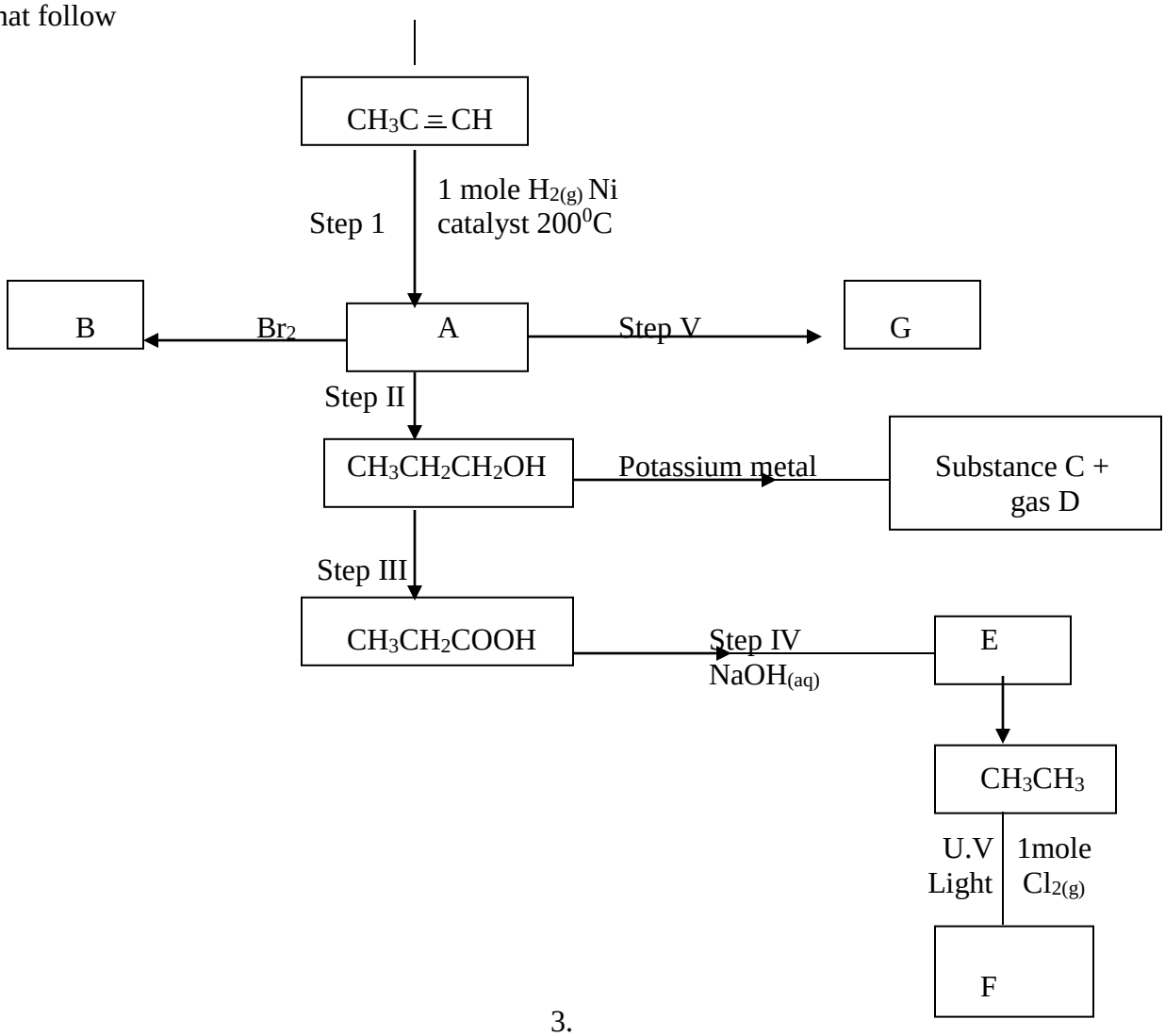
_____

_____

_____

_____

2. The scheme below shows some reactions starting with propyne. Study it and answer the questions that follow



(a) Give the formular of compound E. (1 mark)

_____

_____

_____

(b) Name substance (1 mark)

B _____

C _____

(c) Name the type of reaction(s) taking place in (2 marks)

Step I _____

Step III _____

(d) State the reagents and conditions required for the formation of the following substances. (2 marks)

CH_3CH_3

Reagent

_____

_____

_____

Condition

_____

_____

_____

(e) Write the equation for the formation of B. (1 mark)

_____

_____

_____

(f) Describe a chemical test to differentiate between $CH_3CH_2CH_2OH$ and CH_3CH_2COOH. (2 mark)

_____

_____

_____

_____

(g) Ethanol (CH_3CH_2OH) dissolves readily in water but dimethyl ether (CH_3OCH_3), which has the same number and kind of atoms does not. Explain. (1 mark)

_____

_____

_____

_____

(h) On combustion of a hydrocarbon, 4.4g carbon (IV) oxide and 2.25g water were formed.
Calculate the mass of the hydrocarbon. (2 marks)

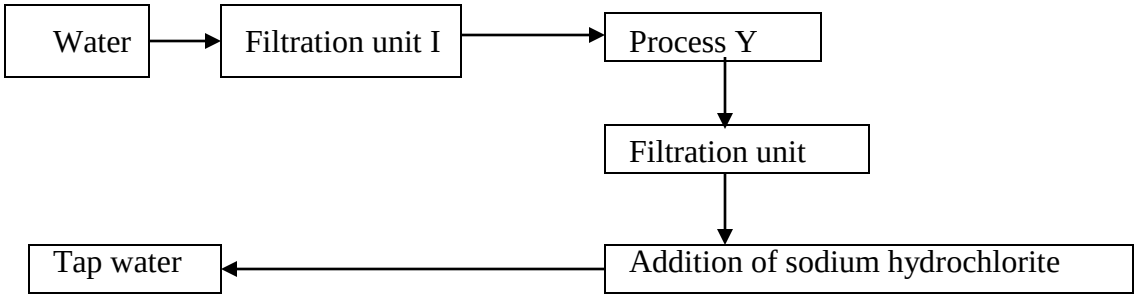
(i) State one advantage of substance G have over natural polymers. (1 mark)

_____

_____

_____

3. The flow chart below shows the various stages of water treatment. Study it and answer the questions that follow.



(a) (i) Which substances are likely to be removed in fitration unit 1? (1 mark)

_____

_____

_____

_____

(ii) What is the name of process Y? (1 mark)

_____

_____

(iii) What is the purpose of

(a) Process Y (1 mark)

_____

_____

_____

(b) Addition of sodium hypochlorite? (1 mark)

_____

_____

_____

(iv) It was confirmed that magnesium sulphate was present in the tap.

(a) What type of hardness was present in the tap water? (1 mark)

_____

_____

_____

(b) Explain how this hardness can be removed. (2 marks)

_____

_____

_____

_____

(v) Name one advantage of hard water. (1 mark)

_____

_____

_____

(vi) How can hydrogen gas being prepared be distinguished from carbon (II) oxide. (1 mark)

_____

_____

_____

_____

(vii) State two advantages of using hydrogen automobile engine fuel over fossil fuel. ((2 marks)

_____

_____

_____

_____

_____

(viii) The hydrogen gas being prepared above reduce the oxide of Q. Element R cannot reduce the oxide of Q. Q cannot reduce the oxide of T but W can. Arrange the four metals in order of reactivity starting with the most reactive. (1 mark)

_____

_____

_____

_____

4 I II III Ground level Sulphur bed

(a) Label the pipe through which superheated water is pumped in. (1 mark)

(b) (i) What is the purpose of the hot air under pressure which is forced down the inner most pipe? (1 mark)

_____

_____

_____

(ii) What is the percentage purity of the sulphur obtained in the above process? (1 mark)

_____

_____

_____

_____

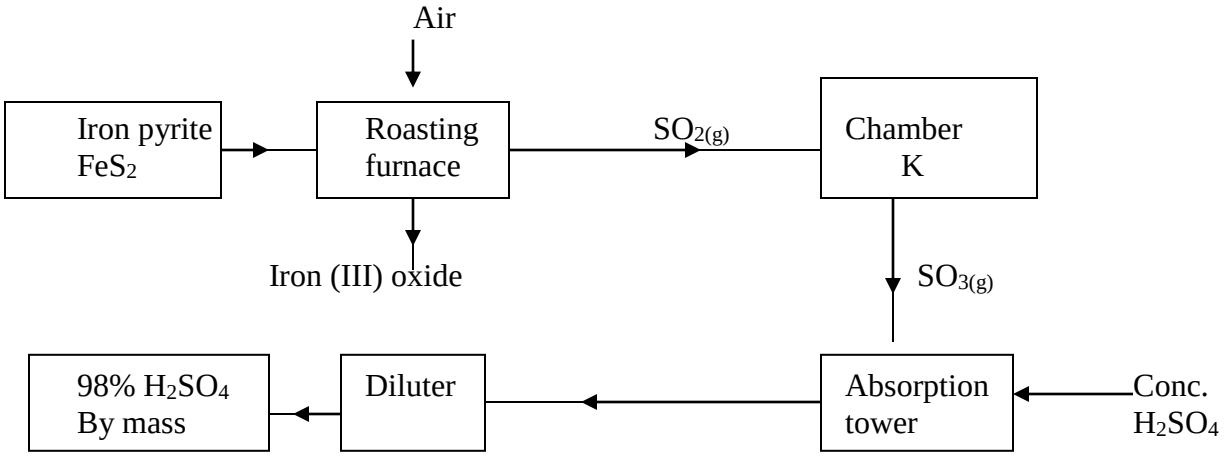
(c) Name the two allotropes of sulphur. (2 marks)

_____

_____

_____

(d) Study the chart below and answer the questions that follow.



(i) Why is iron pyrite used instead of sulphur in this process. (1 mark)

(ii) Give one disadvantage of using the iron pyrites (1 mark)

(e) Why is V_2O_5 commonly used in chamber K than Pt or silica (1 mark)

(f) Explain why sulphur VI oxide is not directly absorbed into water. (1 mark)

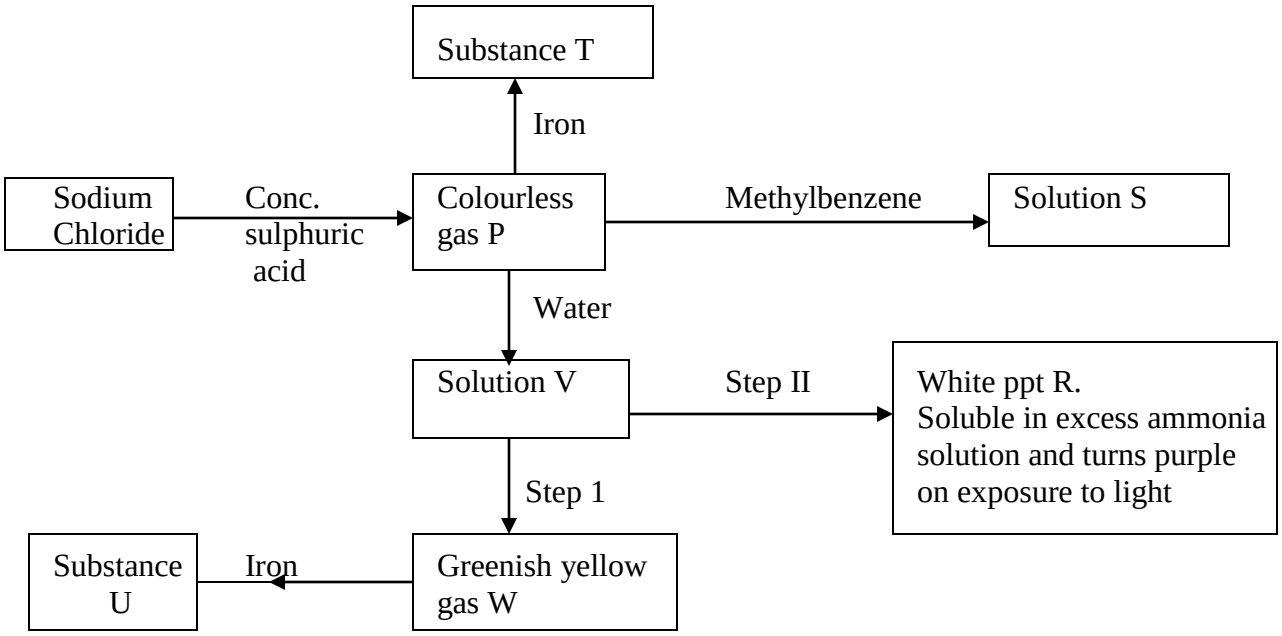
(g) State the observation made when

(i) Hydrogen sulphide gas is bubbled through a solution of iron (III) sulphate. (1 mark)

(ii) Copper turnings are heated with concentrated sulphuric VI acid. (1 mark)

(iii) Wet blue litmus paper is dipped into a gas jar of sulphur (IV) oxide gas. (1 mark)

5. Study the flow chart below for a series of chemical reactions.



(a) (i) Identify the gas P and W. (2 marks)

_____

_____

_____

_____

(ii) Name substances. (2 marks)

R _____

T _____

(b) What effect does solution V and S have on litmus paper. Explain. (2 marks

_____

_____

_____

_____

(c) What observation is made if excess ammonia gas is added to P? Explain. (2 marks)

_____

_____

_____

_____

(d) Name reagents used in steps I and II. (2 marks)

_____

_____

_____

_____

(e) Gas P and W react with hot iron to form two different products. Explain. (2 marks)

_____

_____

_____

_____

6 NaCl Chlorine Sodium Hood Fire brick wall Anode Cathode Molten electrolyte

(a) What is the purpose of the fire brick wall lining. (1 mark)

_____

_____

_____

(b) Give the composition of the electrolyte. (1 mark)

_____

_____

_____

(c) Although the M.P of NaCl is 800^0C, electrolysis takes place at about 600^0C. Explain. (2 marks)

_____

_____

_____

_____

(d) What is the anode made of? Give a reason. (2 marks)

(e) Name material used to separate the two electrodes and its purpose. (2 marks)

(f) State two properties of sodium that make it to be used as a "Coolant" in nuclear reactors. (2 marks)

7. (a) Use the circuit below to answer the questions that follow.
Distilled water Glass tube Platinum electrodes Bulb

(i) The bulb did not light with distilled water in the glass tube. Explain. (1 mark)

(ii) A small piece of sodium was dropped in the glass tube and the bulb began to glow. Explain. (1 mark)

(iii) When the bulb started to glow, bubbles were seen at both electrodes.
Show the products formed at each electrode using equations.
Anode

_____

_____

_____

Cathode

_____

_____

_____

(b) Use the following standard reduction, potential for a number of half-reactions to answer the questions that follow.

Half reaction	EO/Volts
$Ag^{+}_{(aq)} + e^{-} \longrightarrow Ag_{(s)}$	0.799
$Mg^{2+}_{(aq)} + 2e^{-} \longrightarrow Mg_{(s)}$	-2.37
$Cd^{2+}_{(aq)} + 2e^{-} \longrightarrow Cd_{(g)}$	-0.402
$2H^{+}_{(aq)} + 2e^{-} \longrightarrow H_{2(g)}$	0.00
$Ce^{4+}_{(aq)} + e^{-} \longrightarrow e^{-}$	1.61
$Mn^{2+}_{(aq)} + 2e^{-} \longrightarrow Mn_{(s)}$	-1.18

(i) Identify the strongest reducing agent. Give a reason for your answer. (2 marks

_____

_____

_____

(ii) Select one species from the table that could be used to oxidize silver to silver ions. (1 mark)

_____

_____

_____

(iii) Write an equation for the reaction in (3b) (ii) (1 mark)

_____

_____

_____

_____

(iv) Given the two half reactions

$Mg^{2+}_{(aq)} + 2e^- \longrightarrow Mg_{(s)}$ and $Cd^{2+}_{(aq)} + 2e^- \longrightarrow Cd_{(s)}$

I) Write the cell representation notation made up of these two half reactions. (1 mark)

_____

_____

_____

_____

II) Write down the overall cell reaction for the cell formed by these two half reactions. (1mark)

_____

_____

_____

_____

III) Calculate the e.m.f for the cell formed by the two half-cells in II above. (1 mark)

_____

_____

_____

_____

_____

_____

_____

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_____

_____

233/2
CHEMISTRY
PAPER 2
THEORY
JULY 2011

MAKINDU DISTRICT INTER-SECONDARY SCHOOLS EXAMINATION
PRE - Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 2

MARKING SCHEME

1. (a) Alkaline earth metals
   (b) $2C_{(s)} + 3Cl_{2(g)} \longrightarrow 2CCl_{3(s)}$ Penalise ½ mark for missing state
   (c) - Element E is more reactive than G. √1
   - Atom of E has smaller radius and thus greater nuclear attraction to gain electrons √1

   (d) - Atomic radius of B is greater than that of E. √1
   - Atom of E has more protons and electrons which increase attraction force, pulling outer energy level closer to nucleus reducing radius.

   (e) 2.8.8
   (f) (i) SiO_2 has very high M.P than $SiCl_4$.
   - SiO_2 has giant covalent structure strong covalent bond require high temp to weaken and melt
   - $SiCl_4$ has simple molecular structure ; weak van der waals forces between molecules are easily broken
   (ii) - Al_2O_3 and SiO_2 are amphoteric oxides
   (iii) - PCl_3 when dissolved in water produces HCl which make the solution acidic
   NaCl is not hydrolysed by water, remain neutral.

2. (a) CH_3CH_2COONa
   (b) B – 1, 2-dibromopropane √1
   C – Potassium propanoxide
   (c) I – Hydrogenation
   III – Oxidation

   (d) - Reagent – soda lime NaOH / $Ca(OH)_2$ accept formular
   - Condition – heat
   (e) $CH_3CH = CH + Br_2 \longrightarrow CH_3CHBrCHBr$
   (f) React each separately with sodium hydrogen Carbonate in a test tube
   CH_3CH_2COOH – Gives effervescence
   CH_3CH_2OH – Does not produce any effervescence

   (g) Elthanol – has hydrogen bonding
   - Polar
   Dimethyl ether has no hydrogen bonding
   - Non-polar

(h) Mass of C $= {}^{12}/_{44}$ x 4.4
$= 1.2g \surd ½$
Mass of H $= {}^{2}/_{18}$ x 2.25
$= 0.25 \surd ½$
Mass of hydrocarbon = 1.2 + 0.25 $\surd ½$
$= 1.45g \surd ½$
Penalise ½ mark for missing units

(i) - Less expensive / cheap
- Less affected by reagents such as acids and alkali
- Less denser but stronger Any √1

3. (a) (i) Large suspended particles e.g leaves, stones, sand, gravel / grit
(ii) Sedimentation or precipitation
(iii) (a) Causes the small suspended particles to settle / precipitate
(b) Destroy micro-organism
(iv) (a) Permanent hardness
(b) Addition of washing soda (Na_2CO_3) which precipitate $Mg^{2+}_{(aq)}$ as $MgCO_{3(s)}$

(v) - Use distillation and remove residue, $MgSO_4$ is left behind
- Use ion exchange resins which will remove $Mg^{2+}_{(aq)}$ ions.
(vi) - H_2 gas – burns with a blue flame
Co gas – burns with pale blue flame
Or
H_2 – explodes and burns with a "pop" sound when a burning splint is brought near the mouth of a gas jar containing H_2.
CO – does not produce "pop" sound.
Or Test for the products

(i) $H_2 \longrightarrow H_2O$ – turns white anhydrous $CuSO_4$ to blue
$CO \longrightarrow CO_2$ - does not turn

(ii) $H_2 \rightarrow H_2O$ – does not form white ppt with calcium hydroxide solution.
$CO \rightarrow CO_2$ – forms white ppt with calcium hydroxide solution
Any 1 comparison

(vii) W, T, Q, R
(viii) H_2 – produces more energy per molecule
- Products after combustion harmless to environment

4. (a) Tube (III) (outermost / widest pipe)
(b) (i) Forces froth of molten sulphur up
(ii) 99%
(c) Rhombic sulphur
Monoclinic sulphur

(d) (i) Cheaper to oxidize
(ii) -SO_2 produce is impure
- Time consuming to remove impurities
- Expensive
- Impurities poison catalyst Any 2

(e) - Less poisoned by impurities
- Less expensive Any 1

(f) Reaction of SO_3 and water is V. exothermic and causes dangerous acid spray.

(g) (i) Observation – Brown iron (III) ions turn to green II ions √1
(ii) Observation – Blue solution forced √1
(iii) Observation - Blue litmus paper turns to red √ ½
- Later paper turn white √ ½

5. (a) (i) Gas P – hydrogen chloride √1
Gas W – Chlorine gas √1
(ii) R – Zinc (II) hydroxide √
T - Iron (II) chloride √1

(b) Solution V turns blue litmus paper red while solution S does not √1
Hydrogen chloride dissolves in water to form hydrochloric acid but when in methylbenzene not acidic √1

(c) White dense fumes √1 due to formation of ammonium chloride √1

(d) Step I – $KMnO_4$ or $MnCl_2$ √1
Step II – Zinc metal √1

(e) Gas P forms iron (II) chloride with iron metal because it is not an oxidizing agent while gas W forms iron (III) chloride.

6. (a) - Maintain high temp
- Prevent electrolyte from crystallizing

(b) NaCl
- $CaCl_2$ } √1

(c) - 40% $CaCl_2$ added to lower M.P
- Save electricity used in heating

(d) - Anode – made of graphite
- Graphite is inert, does not react with Cl_2 gas produce

(e) - Steel diaphragm
- Prevent recombination of sodium and chlorine

(f) Na - High thermal conductivity
- High specific heat capacity
- Low M.P Any 2

7. (a) (i) Water is a weak electrolyte and does not undergo complete dissociation / ionization √1
(ii) The reaction produced a solution of NaOH which is a strong electrolyte, having mobile ions, which can conduct the electric current √1
(iii) Anode $4OH^-_{(aq)} \longrightarrow O_{2(g)} + 2H_2O_{(l)} + 4e^-$ √1
Cathode $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$ √1

(b) (i) Mg^{2+} ; has the highest negative potential √1

(ii) Mg^{2+} √1

(iii) $Mg^{2+}_{(aq)} + 2Ag_{(s)} \longrightarrow Mg_{(s)} + 2Ag^{+}_{(aq)}$ √

I) $Mg_{(s)} / Mg^{2+}_{(aq)} // Cd^{2+}_{(aq)} / Cd_{(s)}$ √1

II) $Mg_{(s)} + Cd^{2+}_{(aq)} \longrightarrow Mg^{2+}_{(aq)} + Cd_{(s)}$ $E^{\theta} = 1.968$ V √1

III) e.m.f = -0.402 - $^{-}$2.37

= 1.968V √1

Name _____ Index No. _____

Candidate's signature _____

Date _____

233/3
CHEMISTRY
PAPER 3
PRACTICAL
JULY 2011
2 ¼ HRS

MAKINDU DISTRICT INTER-SECONDARY SCHOOLS EXAMINATION
PRE - Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3
2 ¼ HRS

INSTRUCTIONS TO CANDIDATES

- Write your name and index number in the spaces provided above .
- You are not allowed to start working with apparatus for the first 15 minutes of the 2 ¼ hours allowed for the paper. Use this time to read through the paper and ensure you have all apparatus and chemicals you need.
- Electronic calculators may be used.
- All working MUST be clearly shown.
- This paper consists of 9 printed pages

FOR EXAMINER'S USE ONLY

Question	Max. Score	Candidate's scores
1	15	
2	13	
3	12	
Total Score	40 (marks)	

This paper consists of 9 printed pages

Turn Over

Question 1

You are provided with,

- 2g of mixture of anhydrous oxalic acid and sodium oxalate solid H
- 0.02M potassium manganate (VII) solution V
- 0.1M sodium hydroxide, solution W

You are required to determine the percentage of sodium oxalate in solid H.

Procedure 1

1. Transfer all the 2g of solid H into a 250ml volumetric flask and add 100cm^3 distilled water to dissolve the solid. Add more water to make up to 250cm^3 mark. Shake it well and label it solution H.
2. Fill the burette with solution W.
3. Using a pipette and pipette filler, transfer 25cm^3 of solution H into a conical flask. Add 2 drops of phenolphthalein indicator.
4. Titrate solution H with solution W and record your readings in the table below
5. Repeat the titrations two more times to complete the table.

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution W used (cm^3)			

(3 marks)

Volume of pipette used _____cm^3

(a) Calculate the average volume of solution W used. (½ mark)

Procedure II

1. Fill a burette with solution V.
2. Using a pipette and pipette filler, place 25cm^3 of solution H into a conical flask.
3. Warm solution H to about 65^0C. Titrate the hot solution H with solution V until a permanent pink colour persists

   Record the readings in table II below.
4. Repeat the titrations to complete the table.

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution V used (cm^3)			

(3 marks)

Volume of pipette used _____cm^3

(b) Calculate the average volume of solution V used. (½ mark)

(c) Calculate the moles of sodium hydroxide that reacted. (½ mark)

(d) Given that sodium hydroxide reacts with oxalic acid as shown in the equation.

$$2NaOH_{(aq)} + H_2C_2O_{4(aq)} \longrightarrow Na_2C_2O_{4(aq)} + 2H_2O_{(l)}$$

Calculate the'

(i) Number of moles of oxalic acid in $25cm^3$ of solution H. (1 mark)

(ii) Number of moles of oxalic in 250cm3 of solution H. (½ marks)

(e) Calculate the'

(i) Number of moles of solution V reacting. (½ mark)

(ii) Number of moles of H in $25cm^3$ of solution H given that 2 moles of potassium manganate (VII) (solution V) reacted completely with 5 moles of oxalate ($C_2O_4^{2-}$) ions in solution H. (1½ marks)

(iii) Number of moles of H in $250cm^3$ of solution. (1 mark)

(iv) Number of moles of sodium oxalate in the mixture (solid H) using results in d(ii) and e(iii) above. (1 mark)

(v) Mass of sodium oxalate ($Na_2C_2O_4$) in the mixture. (1 mark)

(vi) The percentage of sodium oxalate in the mixture. (1 mark)

2. You are provided with:
   - 2 100ml beakers
   - white paper with (X) mark
   - 50ml / 100ml measuring cylinder
   - Stop watch
   - 80ml solution A; 2M HCl
   - 10ml measuring cylinder
   - 120 ml solution B; 0.5M $Na_2S_2O_3$ solution.

You are required to determine the rate of reaction of hydrochloric acid with sodium thiosulphite varies with concentration of HCl.

Procedure

- Measure 30ml sodium thiosulphite solution B using the 100ml measuring cylinder and place it into a 100ml glass beaker.
- Place the beaker on the white paper with a (X) mark.
- Measure 10ml of solution A, 2M HCl
- Add the 10ml solution A into the beaker containing solution B and simultaneously start a stop watch
- Swirl the mixture and place it back to the white paper.
- Observe the cross through the solution from above and stop the watch when the cross <u>just</u> disappears.
- Record the time taken in the table below.
- Repeat the procedure with the other sets of mixture of sodium thiosulphite and distilled water as shown in the table .
- Complete the table.

Experiment	1	2	3	4	5	6
Volume of $Na_2S_2O_3$ solution (cm^3)	30	25	20	15	10	5
Volume of D. Water add (cm^3)	0	5	10	15	20	25
Concentration of solution (mol/dm^3)	0.15					0.025
Time taken for cross to disappear (sec)						
$^1/_t$						

(9 marks)

(b) Plot a graph of $^1/_t$ (sec^{-1}) against concentration . (3 marks)

(c) From your graph determine the

(i) Time taken for the reaction to end when the concentration is 0.12. (1 mark)

(ii) Concentration when the time taken is 90 sec. (1 mark)

(d) From the graph what is the effect of concentration on the rate of reaction. (1 mark)

3. You are provided with solid M. Carry out the tests below. Write your observations and inferences in the spaces provided.

(a) Use a clean metallic spatula, heat about one quarter of solid M in a Bunsen burner flame.

Observations	Inferences
(½ mark)	(1 mark)

(b) Put the remaining portion of solid M into a boiling tube and add about $10cm^3$ of distilled water. Stir and filter. Keep the residue for further tests. Divide the filtrate into four portions

(i) To the first portion, add sodium hydroxide solution dropwise till excess.

Observations	Inferences
(½ mark)	(1 mark)

(ii) To the second portion, add ammonium hydroxide solution dropwise till excess.

Observations	Inferences
(½ mark)	(1 mark)

(iii) To the third portion, add lead nitrate solution then warm.

Observations	Inferences
(½ mark)	(1 mark)

(iv) To the forth portion, add barium chloride solution followed by hydrochlorine acid.

Observations	Inferences
(½ mark)	(1 mark)

(c) (i) Dissolve the residue in $5cm^3$ of hydrochloric acid and divide the resulting solution into two portions.

Observations	Inferences
(½ mark)	(½ mark)

(ii) To the first portion add sodium hydroxide solution till in excess.

Observations	Inferences
(1 mark)	(1 mark)

(iii) To the second portion, add ammonium hydroxide solution dropwise tillexcess.

Observations	Inferences
(1 mark)	(1 mark)

233/3
CHEMISTRY
PAPER 3
PRACTICAL
JULY 2011

MAKINDU DISTRICT INTER-SECONDARY SCHOOLS EXAMINATION
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3

MARKING SCHEME

1. Table 1 results

	I	II	III
Final burette readings (cm^3)	21.2	21.1	21.2
Initial burette readings (cm^3)	0.0	0.0	0.0
Volume of solution W used (cm^3)	21.2	21.1	21.2

(3marks)

NB: Mark according to school value i.e $x \pm 0.1$ √1
$x \pm 0.2$ √ ½

Volume of pipette used $25cm^3$

(a) Average volume = $\frac{21.2 + 21.1 + 21.2}{2}$ √ ½ = $21.166 \pm 0.1cm^3$ √ ½

Table 2

	I	II	III
Final burette reading	28.3	28.3	28.3
Initial burette reading	0.1	0.1	0.1
Volume of solution V used (cm^3)	28.2	28.2	28.2

(3 marks)

Volume of pipette used $25cm^3$

(b) Average volume = $\frac{28.2 + 28.2 + 28.2}{3}$ √ ½ = $28.20cm^3$

(c) Moles of NaOH = $\frac{0.1 \times 21.166}{1000}$ √ ½ = 0.0021 mole

(d) (i) Moles of oxalic acid = ½ (moles of NaOH) √ ½ = $\frac{0.0021}{2}$ = 0.00105 mole √ ½

(ii) Moles of oxalic acid in $250cm^3$
→ If $25cm^3$ → 0.00105
$250cm^3$ → ?
→ $\frac{250}{25} \times 0.00105$ √ ½ = 0.0105 √1

(e) (i) Moles of V = $\frac{0.02 \times 28.3}{1000}$ = 0.000566 mole √ ½

This paper consists of 4 printed pages

Turn Over

(ii) $MnO4^-$: H (C_2O4^{2-})
2 : 5
If 2 → 0.000566 ⟶ $^5/_2$ x 0.000566 √ ½ = 0.001415 mole √1
5 → ?

(iii) If 25cm^3 ⟶ 0.001415 moles
250cm^3 ⟶ ?
$\frac{250}{25}$ x 0.001415 √ ½ = 0.01415 mole √ ½

(iv) Moles of $Na_2C_2O_4$ = e (iii) – d (ii) √ ½
= 0.01415 – 0.0105
= 0.00365 mole √ ½

(v) Mass of $Na_2C_2O_4$ = moles x RMM of $Na_2C_2O_4$
= 0.00365 x 134 √ ½
= 0.4891g √ ½

(vi) % of $Na_2C_2O_4$ = $\frac{0.4891}{2}$ x 100% √ ½
= 24.455% √ ½

2.

Experiment	1	2	3	4	5	6
Volume of $Na_2S_2O_3$ solution (cm^3)	30	25	20	15	10	5
Volume of D. Water added (cm^3)	0	5	10	15	20	25
Concentration of $Ha_2S_2O_3$ solution (mol/dm^3)	0.15	0.125 √ ½	0.10	0.075	0.05	0.025
Time taken for cross to disappear (sec)	22	26	32	40	68	125
$^1/_t$ (sec^{-1})	0.045	0.038	0.031	0.025	0.015	0.008

$^1/_t$ = 3 d.p
Concn. = 3 d.p √ ½
Any 14 = 7 marks

(c) (i) 0.0365 sec^{-1} ⟶ 27 sec ± 2 √1

(ii) 90 sec = 0.011 sec^{-1} ⟶ 0.036 mol /dm^3 ± 0.002 √1

(d) When concentration increases, the rate of reaction increases. √1

$^{1}/_{t}$ sec^{-1} √ ½ x 10^{-2} 4 3 2 1 0 2 4 6 8 10 12 14 16 √2
Graph – straight line √1
Pass through origin

Scale
y – 4 bg repr. 1 x 10^{-2} sec^{-1}
x – 1bg repr. 1 x 10^{-2} mol/dm^3

1 mark – straight line graph
1 mark – labeling axes
1 mark – scale
Concentration of $Ha_2S_2O_3$ solution mol/dm^3 x 10^{-2} √ ½
Graph of $^{1}/_{t}$ against concentration.

3.

Observations	Inferences
(a) Bluish green flame √ ½	Cu^{2+} ions √ ½
(b) (i) White precipitate formed, soluble in excess √ ½	Al^{3+}, Pb^{2+}, Zn^{2+} ions √1
(ii) White precipitate formed, Soluble on warming √ ½	Zn^{2+} ions √1
(iii) White precipitate formed, Insoluble on warming √ ½	SO_4^- ions √1
(iv) White precipitate formed, Insoluble on adding HCl √ ½	SO_4^{2-} ions √1
(c) (i) Effervescences / bubbles are produced √ ½	CO_3^{2-} / HCO_3^- or SO_3^{2-} ions √ ½
(ii) Blue precipitate formed, Insoluble in excess √1	Cu^{2+} ions √1
(iii) Blue precipitate, Soluble in excess forming deep blue colouration √1	Cu^{2+} ions √1