Name .... Index Number ....

233/2
CHEMISTRY
Paper 2
Nov. 2016
2 hours

Candidate's Signature ....

Date ....

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
CHEMISTRY
Paper 2
(THEORY)
2 hours

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) *KNEC mathematical tables and silent non-programmable electronic calculators may be used.*
(e) ***All** working **must** be clearly shown where necessary.*
(f) ***This paper consists of 12 printed pages.***
(g) ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***
(h) ***Candidates should answer the questions in English.***

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1	11	
2	12	
3	13	
4	11	
5	10	
6	12	
7	11	
Total Score	80	

1. Use the information in the table below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Atomic number	Melting point °C
R	11	97.8
S	12	650.0
T	15	44.0
U	17	−102
V	18	−189
W	19	64.0

(a) Give a reason why the melting point of:

(i) S is higher than that of R. (2 marks)

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(ii) V is lower than that of U. (2 marks)

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(b) How does the reactivity of W with chlorine compare with that of R with chlorine? (2 marks)

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(c) Write an equation for the reaction between T and excess oxygen. (1 mark)

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(d) When 1.15 g of R was reacted with water 600 cm^3 of gas was produced. Determine the relative atomic mass of R. (Molar gas volume = 24000 cm^3) (3 marks)

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(e) Give **one** use of element V. (1 mark)

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2. (a) Describe the process by which nitrogen is obtained from air on a large scale. (4 marks)

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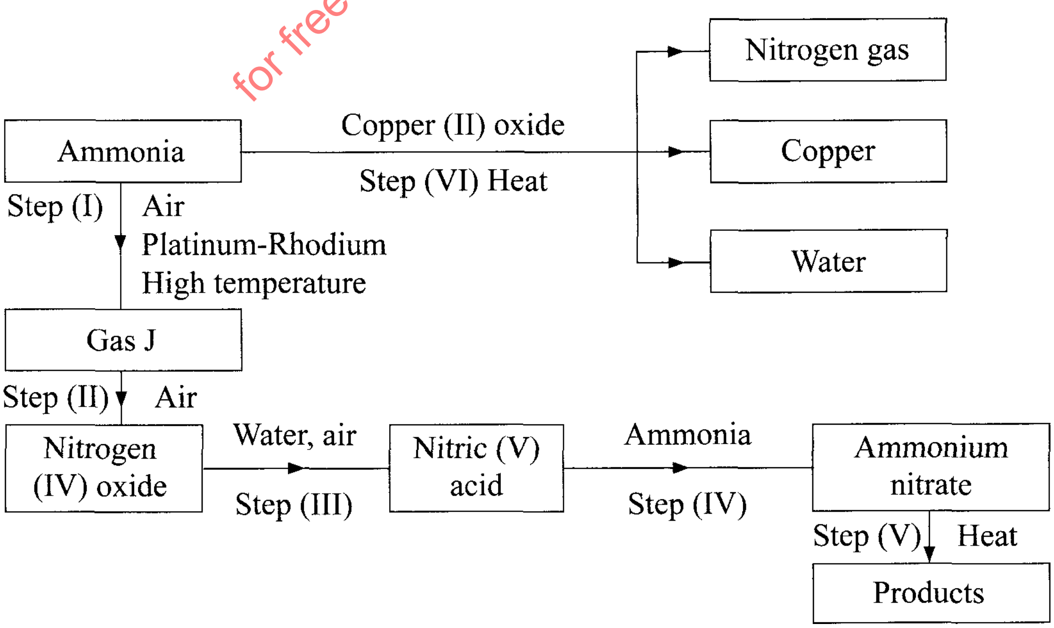
(b) Study the flow chart below and answer the questions that follow.



(i) Identify gas J. (1 mark)

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(ii) Using oxidation numbers show that ammonia is the reducing agent in step (VI) (2 marks)

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(iii) Write the equation for the reaction that occurs in step (V). (1 mark)

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(iv) Give **two** uses of ammonia nitrate. (2 marks)

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(c) The table below shows the observation made when aqueous ammonia was added to cation of elements E, F and G until in excess.

Cation of	Addition of a few drops of aqueous ammonia	Addition of excess aqueous ammonia
E	White precipitate	Insoluble
F	No precipitate	No precipitate
G	White precipitate	Dissolves

(i) Select the cation that is likely to be Zn^{2+}. (1 mark)

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(ii) Given that the formula of the cation of element E is E^{2+} write the ionic equation for the reaction between E^{2+} (aq) and aqueous ammonia. (1 mark)

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3. (a) Methanol is manufactured from carbon (IV) oxide and hydrogen gas according to the equation.

$$CO_{2(g)} + 3H_{2(g)} \rightleftharpoons CH_3OH_{(g)} + H_2O_{(g)}$$

The reaction is carried out in the presence of a chromium catalyst at 700K and 300k pa. Under these conditions, equilibrium is reached when 2% of the carbon (IV) oxide is converted to methanol.

(i) How does the rate of the forward reaction compare with that of the reverse reaction when 2% of the carbon (IV) oxide is converted to methanol? (1 mark)

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(ii) Explain how each of the following would affect the yield of methanol:

I reduction in pressure (2 marks)

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II using more efficient catalyst (2 marks)

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(iii) If the reaction is carried out at 500k and 300k pa, the percentage of carbon (IV) oxide converted to methanol is higher than 2%.

I What is the sign of ΔH for the reaction? Give a reason (2 marks)

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II Explain why in practice the reaction is carried out at 700K but not at 500K (2 marks)

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(b) Hydrogen peroxide decomposes according to the following equation:

$2H_2O_2\,(aq) \rightarrow 2H_2O(l) + O_2(g)$

In an experiment the rate of decomposition of hydrogen peroxide was found to be 6.0×10^{-8} moldm^{-3}S^{-1}

(i) Calculate the number of moles per dm^3 of hydrogen peroxide that has decomposed within the first 2 minutes. (2 marks)

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(ii) In another experiment, the rate of decomposition was found to be 1.8×10^{-7} moldm^{-3}S^{-1}. The difference in the two rates could have been caused by addition of a catalyst. State giving reason, **one** other factor that may have caused the difference in the two rates of decomposition. (2 marks)

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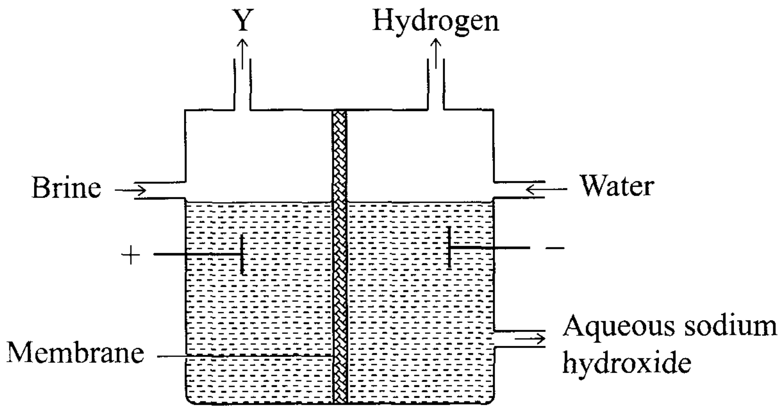
4. (a) The set up below can be used to produce sodium hydroxide by electrolysing brine.



(i) Identify gas Y. (1 mark)

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(ii) Describe how aqueous sodium hydroxide is formed in the above set-up. (2 marks)

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(iii) One of the uses of sodium hydroxide is in the manufacture of soaps. State **one** other use of sodium hydroxide. (1 mark)

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(b) Study the information given below and answer the questions that follow

Half reactions	Electrode potential $E^{\theta}V$
$D^{2+}_{(aq)} + 2e \longrightarrow D_{(s)}$	-0.13
$E^{+}_{(aq)} + e \longrightarrow E_{(s)}$	$+0.80$
$F^{3+}_{(aq)} + e \longrightarrow F^{2+}_{(aq)}$	$+0.68$
$G^{2+}_{(aq)}\ 2e \longrightarrow G_{(s)}$	-2.87
$H^{2+}_{(aq)} + 2e \longrightarrow H_{(s)}$	$+0.34$
$J^{+}_{(aq)} + e \longrightarrow J_{(s)}$	-2.71

(i) Construct an electrochemical cell that will produce the largest e.m.f. (3 marks)

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(ii) Calculate the e.m.f. of the cell constructed in (i) above. (2 marks)

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(iii) Why is it not advisable to store a solution containing E+ ions in a container made of H? (2 marks)

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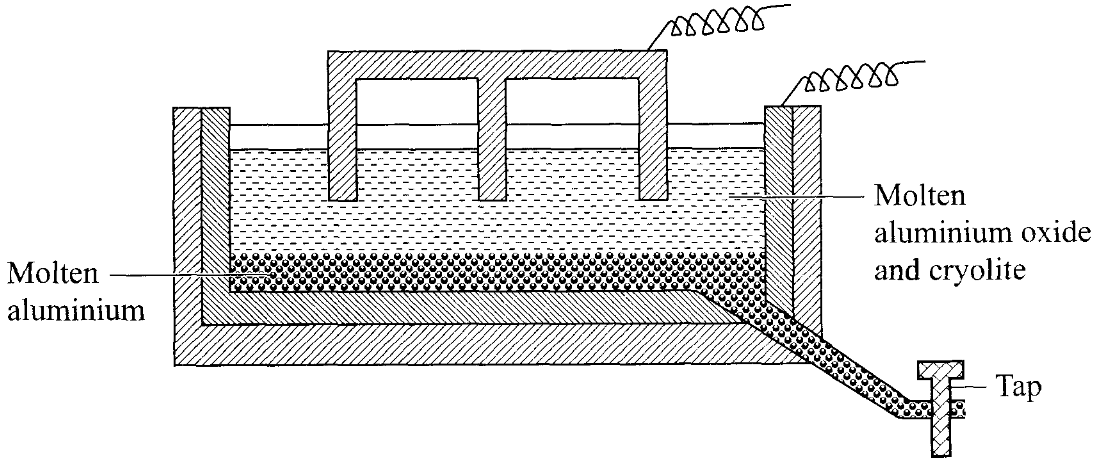
5. The diagram below represents a set up of an electrolytic cell that can be used in the production of aluminium.



(a) On the diagram, label the anode. (1 mark)

(b) Write the equation for the reaction at the anode. (1 mark)

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(c) Give a reason why the electrolyte process is not carried out below 950°C. (1 mark)

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(d) Give a reason why the production of aluminium is not carried out using reduction process. (1 mark)

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(e) Give **two** reasons why only the aluminium ions are discharged. (2 marks)

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(f) State **two** properties of duralumin that makes it suitable for use in aircraft industry. (2 marks)

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(g) Name **two** environmental effects caused by extraction of aluminium. (2 marks)

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6. (a) Draw the structural formula for all the isomers of $C_2H_3Cl_3$. (2 marks)

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(b) Describe **two** chemical tests that can be used to distinguish between ethene and ethane. (4 marks)

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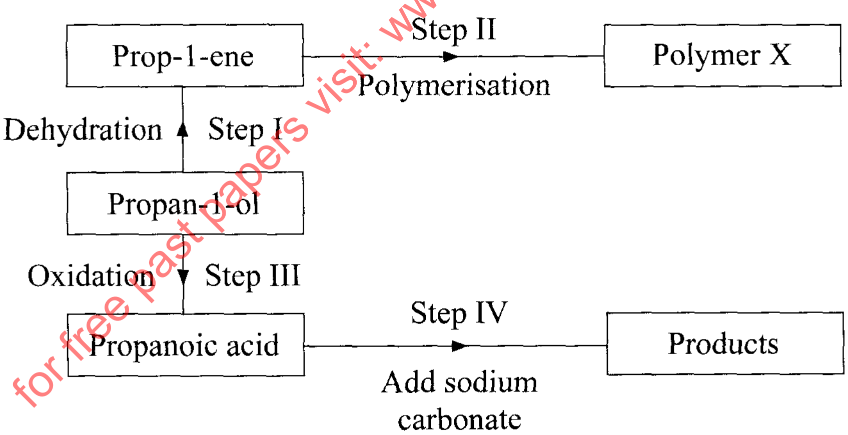
(c) The following scheme represents various reactions starting with propan-l-ol. Use it to answer the questions that follow.



(i) Name **one** substance that can be used in Step I. (1 mark)

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(ii) Give the general formula of X. (1 mark)

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(iii) Write the equation for the reaction in Step IV. (1 mark)

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(iv) Calculate the mass of propan-l-ol which when burnt completely in air at room temperature and pressure would produce $18dm^3$ of gas. (C = 12.0, O = 16.0, H = 1.0; molar gas volume = $24dm^3$) (3 marks)

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7. (a) Write an equation to show the effects of heat on the nitrates of:

(i) Potassium (1 mark)

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(ii) Silver (1 mark)

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(b) The table below gives information about elements A_1, A_2, A_3 and A_4.

Elements	Atomic Number	Atomic radius (nm)	Atomic radius (nm)
A1	3	0.134	0.074
A2	5	0.090	0.012
A3	13	0.143	0.050
A4	17	0.099	0.181

(i) In which period of the periodic table is element A_2? Give a reason. (2 marks)

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(ii) Explain why the atomic radius of:

I A1 is greater than that of A2 (2 marks)

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II A1 is smaller than its ionic radius. (2 marks)

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(iii) Select the element which is in the same group as A3. (1 mark)

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(iv) Using Dots (.) and crosses (x) to represent outermost electrons, draw a diagram to show the bonding in the compound formed when A1 reacts with A4. (2 marks)

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