233/2
CHEMISTRY
PAPER 2
THEORY
TIME: 2 HOURS

ALLIANCE HIGH SCHOOL
MOCK EXAM

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the spaces provided.
2. Non-programmable, silent calculators and KNEC Mathematical tables may be used.
3. All workings **MUST** be clearly shown.

For Examiner's use only

Questions	Maximum Score	Candidate's Score
1	15	
2	15	
3	10	
4	15	
5	10	
6	15	
Total Score	**80**	

This paper consists of 8 printed pages.

Candidates should check the question paper to ensure that all the pages are printed as indicated and that no questions are missing.

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1. The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of elements.


(a) (i) Identify the most reactive metal. Give a reason. (1 mark)

(ii) Why are elements D and M referred to as alkaline earth metals? (1 mark)

(b) How does the atomic radius of H and J compare? Explain. (2 marks)

(c) Write an equation showing how N forms its ions. (1 mark)

d) What type of bonding exists between.

i) C and G: (½ mark)

ii) E and N: (½ mark)

e) State and explain one use of element K. (1 mark)

f) The 1st, 2nd and 3rd ionization energies in (KJ/mol) of elements C and L are given below.

Element	1st I.E	2nd I.E	3rd I.E
C	520	7320	9500
L	420	3100	4800

i) Define the term 1st ionization energy. (1 mark)

ii) Apart from the decrease in energy level, explain the big difference in 1st and 2nd ionization energies. (1 mark)

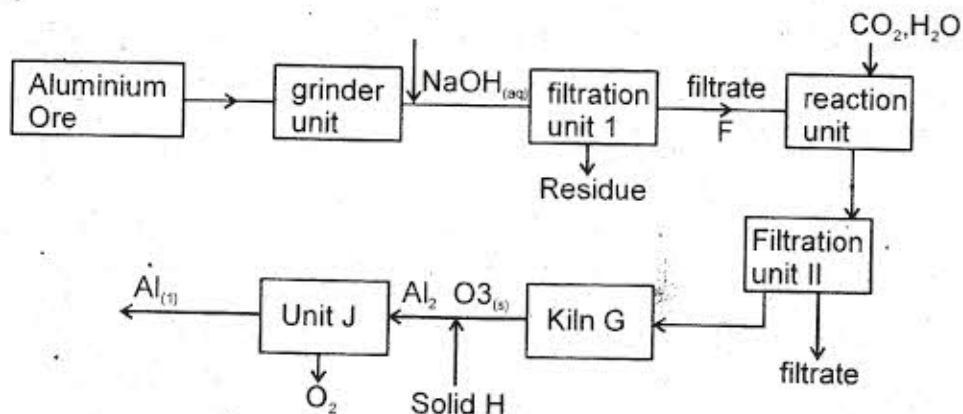iii) Calculate the amount of energy in KJ/mol for the process. (1 mark)

$$L_{(s)} \rightarrow L^{3+}_{(g)} + 3e^-$$
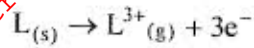
g) Explain the following observations.
   i) Element A can be placed in group I and VII. (1 mark)

   ii) B is placed in group VIII and not II (1 mark)

2. Aluminium metal is extracted from its ore according to the scheme shown below. Study the scheme and answer the questions that follow.

(a) Two ore of aluminium are bauxite, $Al_2O_3.H_2O$ and china clay . Suggest two reasons why bauxite $Al_2S_2O_7.H_2O$ is usually preferred to china clay for extraction of aluminium (2 marks)

(b) i) Iron (III) Oxide and silicates are the main impurities. Identify the chambers where they are removed.
   I) Iron (III) Oxide _____ (1 mark)

   II) Silicate impurities _____ (1 mark)

   ii) What makes dissolving the ore in hot aqueous sodium hydroxide a necessary step? (1 mark)

   iii) Write the formula of one ion in the filtrate F. (1 mark)

   iv) Write an equation to represent the reaction in kiln G. (1 mark)

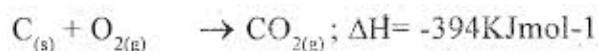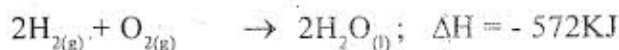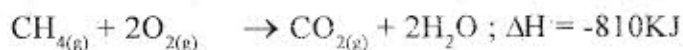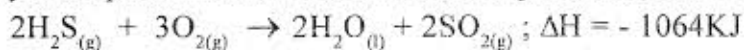   v) Give the name of solid H and explain its function. (1 mark)

   vi) Draw a labeled diagram to show the details of the arrangement in Unit J. (2 marks)

   vii) State the property of aluminium that makes it necessary to use the method of extraction in Unit J. (1 mark)

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3. An experiment was carried out to study the temperature changes when different volumes of 2M potassium hydroxide were added to various volumes of 1M solution of unknown acid X. The results obtained are as shown below.

Experiment	1	2	3	4	5	6	7
Volume of X in the beaker (cm³)	10	15	20	25	30	35	40
Volume of 2M KOH added (cm³)	40	35	30	25	20	15	10
Initial temperature (°C)	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Final temperature (°C)	29.0	33.0	34.5	37.5	36.0	33.5	31.0
Temperature change (°C)							

a) i) Complete the row in the table for the temperature change. (2 marks)

   ii) What is the significance of the temperature in which the greatest temperature change occured? (1 mark)

b) In the experiment 4 calculate:
   i) The number of moles of the acid X used. (1 mark)

   ii) The reacting mole ratios of potassium hydroxide to acid X. (1 mark)

c) From b(ii) above what is the basicity of acid X. (1 mark)

d) Calculate the heat evolved per mole of potasium hydroxide for this reaction (Specific heat capacity of water = 4.2 J⁻¹g⁻¹k⁻¹ and density of water 1g/cm³)

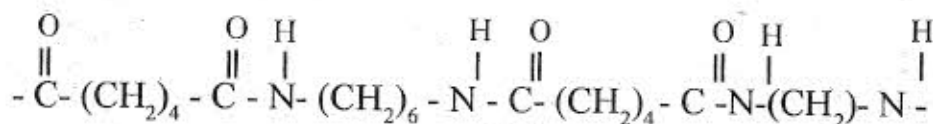e) Study the equation below and answer the questions below.

   $2H_2S_{(g)} + 3O_{2(g)} \rightarrow 2H_2O_{(l)} + 2SO_{2(g)}$; $\Delta H = -1064KJ$

   $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O$; $\Delta H = -810KJ$

   $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$; $\Delta H = -572KJ$

   $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H = -394KJmol-1$

   i) Which gas if used as a fuel would cause the greatest pollution effect assuming no leakages at all? Explain. (1 mark)

   ii) Draw the energy level diagram for the formation of methane (2 marks)

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4. Study the scheme below and answer the questions that follow.
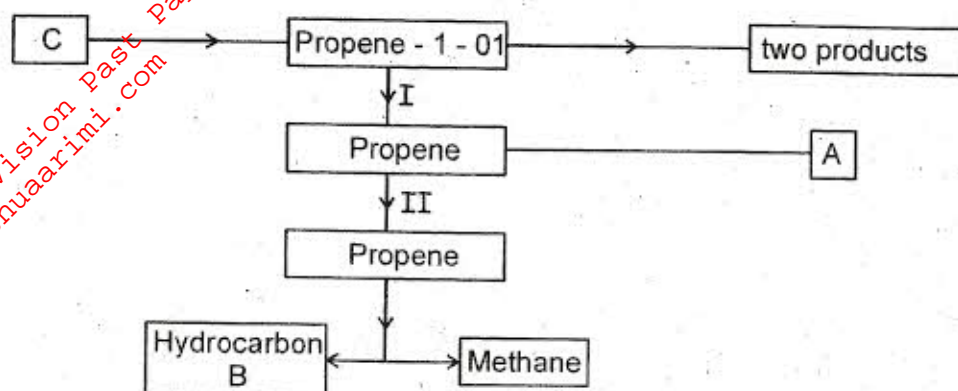
a) Write an equation for the reaction between propan-1-ol and potassium metal. (1 mark)

b) Identify the products A, B and C. (3 marks)

c) Name one catalyst used in process II. (1 mark)

d) Below is the structure of a polymer

$$-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-\overset{H}{\overset{|}{N}}-(CH_2)_6-\overset{H}{\overset{|}{N}}-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-\overset{H}{\overset{|}{N}}-(CH_2)-\overset{H}{\overset{|}{N}}-$$

Draw the monomeric unit (s) of the polymer. (2 marks)

e) i) Give one structural difference between soapless and soapy detergent (1 mark)

ii) What is meant by the term salting out as used in saponification. (1 mark)

iii) Explain how soapless detergents lead to the process of eutrophication in the environment. (2 marks)

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5. In an experiment to study the rate of reaction 2.0g of Manganese (IV) Oxide was added to 100cm³ of hydrogen peroxide solution at 25⁰C. The volume of oxygen released was measured at 10 seconds intervals. The result obtained was tabulated below.

Time (sec)	0	10	20	30	40	50	60	70	80	90
Volume (cm³)	0	60	90	105	112	116	118	120	120	120

a) Plot a graph of gas against time and label it A. (3 marks)

b) Use the graph to find :
   i) Volume of gas produced after 25 seconds.

   ii) The time to produce 80cm³ of oxygen (2 marks)

c) Explain why the volume of oxygen produced does not exceed 120cm³ (1 mark)

d) Sketch a graph B on the same grid to show the results of the experiment if repeated using hydrogen peroxide cooled to 10⁰C. Explain (2 marks)

e) The mass of the solid residue after the experiment was found to be 2.0g when dried. Explain. (1 mark)

f) Explain why chewing of anti acid tablets treats indigestion faster than swallowing the whole tablet. (1 mark)

g) Study the equation below and answer questions that follows.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \qquad H= -189KJmol^{-1}$$
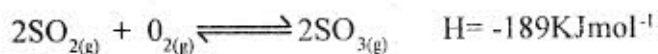
Explain the equilibrium if
i) Pressure was reduced

ii) More of oxygen was introduced to the system

iii) Temperature was increased. (3 marks)

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6. The table below shows the standard reduction potentials of some half reactions. Study it and answer the questions that follow.

E/ Volts

$$Ba^{2+}_{(aq)} + 2e^- \rightleftharpoons Ba_{(s)} \qquad -2.09$$

$$Cr^{3+}_{(aq)} + 3e^- \rightleftharpoons Cr_{(s)} \qquad -0.74$$

$$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}_{(aq)} \qquad +0.77$$

$$Cl_{2(g)} + 2e^- \rightleftharpoons 2Cl^-_{(aq)} \qquad +1.36$$

$$PbO_{2(s)} + 4H^+_{(aq)} + 2e^- \rightleftharpoons Pb^{2+}_{(aq)} + 2H_2O \qquad +1.46$$

$$Cd^{2+}_{(aq)} + 2e^- \rightleftharpoons Cd_{(s)} \qquad -0.40$$

$$2H^+_{(aq)} + 2e^- \rightleftharpoons H_{2(g)} \qquad 0.00$$

$$F_{2(aq)} + 2e^- \rightleftharpoons 2F^-_{(aq)} \qquad +2.87$$

a) Identify the strongest reducing agent. (1 mark)

b) Choose a pair of half cells that you can use to construct a cell that would give the highest e.m.f. Calculate the e.m.f. Write the cell representation of that cell. (3 marks)

c) Draw a labelled diagram of an electro chemical cell which has chromium and Cadmium rods immersed in solutions their respective ions, showing the direction of flow of electric current. Calculate the e.m.f of the cell. (4 marks)

d) Would a solution of barium nitrate be stored in a container made of chromium? Explain your answer using the reduction potential given above. (2 marks)

7. The flow chart below shows the analysis of a mixture Q which consists of two salts. Study it and answer the questions that follow.

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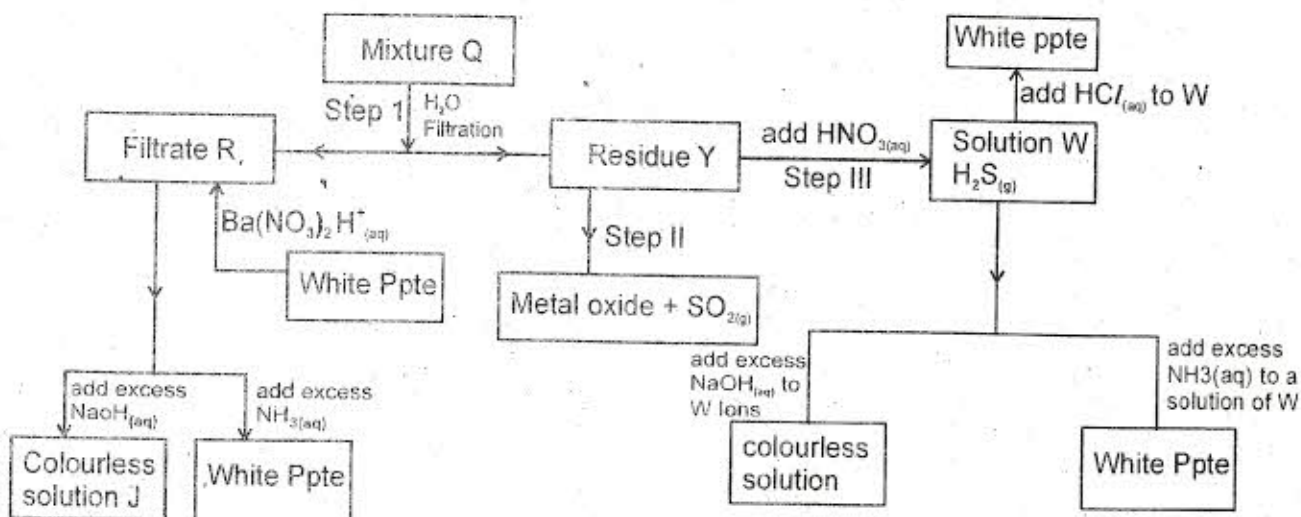
a) What does the process in step 1 suggest about the mixture Q? (1 mark)

b) State the conditions necessary for the reaction in step II to occur. (1 mark)

c) What observations would indicate the presence of H_2S gas in step III. (1 mark)

d) Identify the cations present in filtrate R. (1 mark)

e) Write the formula of the complex ion in solution J give its IUPAC name. (2 marks)

f) State how the gases in step II and III can be distinguished using pieces of moist red litmus. (2 marks)

g) Write an ionic equation for the reaction between dilute Nitric (V) acid and the anions in residue Y. (2 marks)

h) Name the two salts contained in mixture Q. (2 marks)

(i) _____ (ii) _____