KAPSABET HIGH SCHOOL

MARKING SCHEME

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

S			R	E		X	
							V
Q	Z				M		
						T	

i) Identify the most reactive non-metal   1mark

     X

ii) Which of the metal sis the most reactive? Explain.   1mark

Q. has largest atomic radius, outermost electrons are loosely held hence lost easily.

iii) What name is given to the family of elements to which X and T belong?   1mark

     Halogens

iv) Give reasons for the following
     Ionic radius of Q is smaller than that of M   1mark

     Q forms ion by losing electron hence remaining electrons are pulled more close to nucleus, M forms ion by gaining electron, the gained electron is repelled by existing electrons hence repulsive effect increases ionic radius

     Atomic radius of Q is greater than that of S   1mark
     Q has many energy levels than S hence a greater atomic radius than S

v) Give an element that does not form compounds under ideal conditions.
     Explain.   2marks

V, *already is in the stable octet configuration hence does not lose or gain electron*

vi) Give formula of compound formed between E and Z   1mark

ZE$_2$

b) Study the table below and answer the questions that follow.

Substance	A	B	C	D	E	F
Melting point (°C)	801	113 119	-39	5	-101	1356
Boiling point(°C)	1410	445	457	54	-36	2860
Electrical Conductivity (Solid)	Poor	Poor	Good	Poor	Poor	poor
Electrical Conductivity (Liquid)	Good	Poor	Good	Poor	Poor	Poor

i) Identify a substance with:
   a) Giant metallic structure   1mark

C

   b) Has a molecular structure and exists in gaseous state at room temperature
   and pressure   1mark

E

ii) Suggest a reason why substance B has two melting points.   1mark
*Its allotropic // exhibit allotropy*

iii) Substances A and C conduct electric current in the liquid state. State how the two substances

differ as conductors of electric current.   2marks

A is an ionic compound conduct in liquid state as ions are free .in solid they're fixed. C is a metal, conduct in all states using free electrons.

2. Study the flow chart below and answer the questions that follow.
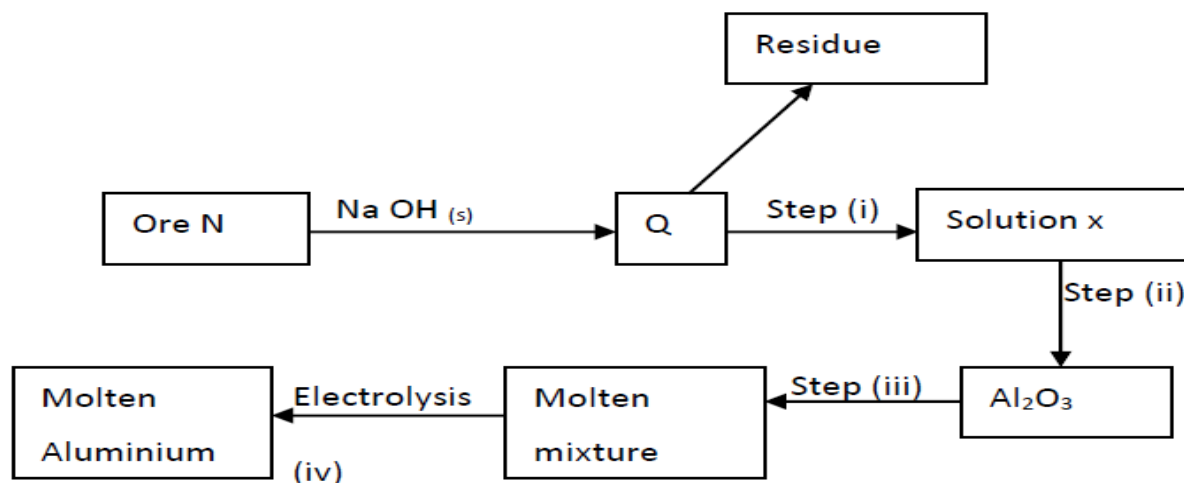
a) Name ore N   1mark
   bauxite

b) Explain why the ore is first dissolved in excess sodium hydroxide solution. 1mark
   To remove impurities of silica and iron iii oxide.

c) Name the major compound present in the residue.   1mark
   Iron (iii) oxide.

d) Give the formula of the aluminium compound present in solution   1mark
   $[Al(OH)_4]^{2+}$

e) **i)** Explain how to obtain aluminium hydroxide from solution X   1mark
   By seeding with pure aluminium hydroxide crystals // bubbling carbon (iv) oxide into it

   ii) Write equation for reaction that takes place in (e) above   1mark
 $2[Al(OH)_4]^- + CO_{2(g)} \longrightarrow 2\,Al(OH)_3 + CO_3^{2-}{}_{(aq)} + H_2O_{(l)}$

   $2[Al(OH)_4]^-{}_{(aq)} \xrightarrow{Al(OH)_3} Al(OH)_{3(s)} + OH^-{}_{(aq)}$

   iii) What is the role of cryolite in the extraction of aluminium.   1mark

   added as impurity to lower melting point of aluminium oxide for electrolysis process

f) Aluminium is a good conductor of electricity. State two uses of aluminium based
   on this property.   2marks
   used *make overhead cables*

g) If sodium carbonate is added to aluminium nitrate solution, effervescence occurs. Explain.   2marks

Aluminium compounds easily hydrolyse releasing hydrogen ions that react with carbonate releasing carbon(iv) oxide causing effervescence.

3. Study the flow chart below and answer the questions that
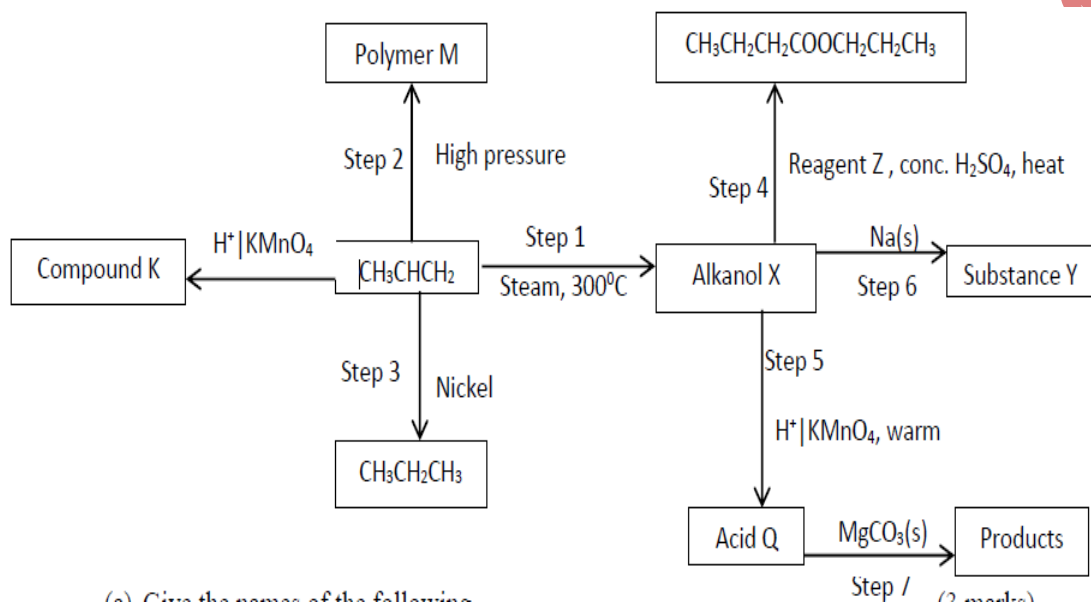
a) Give the names of the following
   i) Compound K   (1mark)

…………………….*ethan – 1,2 -diol*……………………………………

   ii) Substance Y   (1mark)

……………………*sodium propoxide*…………………………………………

   iii) Product obtained in step 4   (1mark)

……………….*propylbutanoate*…………………………………………

(b) Identify the **type of reaction** that takes place in step 1 and give one other condition necessary for the reaction other than the temperature indicated.

Type of reaction…*hydration*………………………   (1mark)

Condition……*pressure of 60 – 70 atm and phosphoric (V) acid as catalyst*…………………. (1mark)

4

c)Draw the structural formula of the following

i) Polymer M   (1mark)

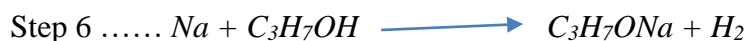ii) Acid Q   (1mark)

d) Give the **industrial application** for the reaction in step 3   (1mark)

…………*Hardening of liquid oil into solids in manufacture of margarine*………………

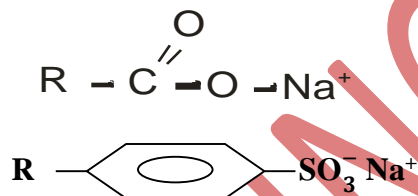e) Write chemical equations for the reactions in step 6 and step 7 .   (2marks)

Step 6 …… $Na + C_3H_7OH \longrightarrow C_3H_7ONa + H_2$

Step 7

……… $C_3H_6O_2 + MgCO_3 \longrightarrow (CH_3CH_2COO)_2Mg + CO_2 + H_2O$

f) The following are structures of two cleansing agents.

$$R - C \overset{O}{\underset{\parallel}{}} - O - Na^+$$

$$R - \langle \bigcirc \rangle - SO_3^- Na^+$$

In the table below, give one advantage and one disadvantage of each of them.   (2marks)

Cleansing Agent	Advantage	Disadvantage
R-COO-Na⁺	*Biodegradable thus non – pollutant*	*Wastes soap, since does not lather readily with hard water forms scum*
R-OSO3-Na⁺	*Does not form scum, since readily lather with hard water*	*Non - biodegradable thus pollutant*

4. The flow chart below illustrates two industrial processes. Harber process and the contact process.
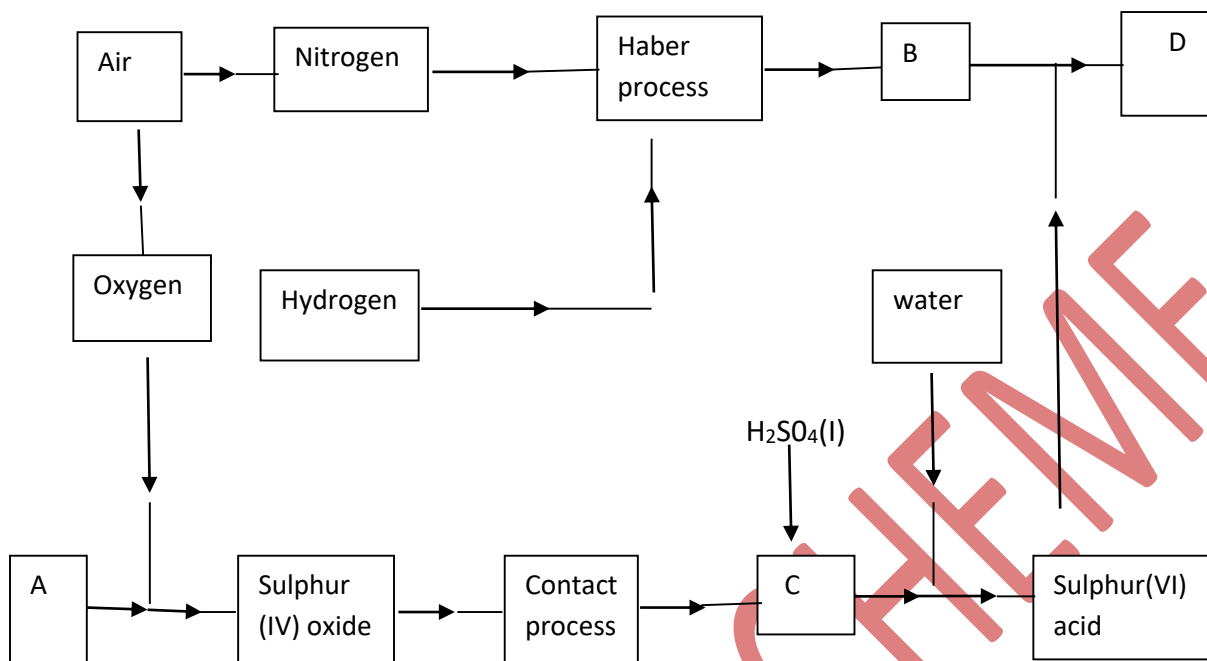
(a).Name the process of obtaining nitrogen from atmospheric air.   (1 mark)

Fractional distillation of liquid air

(b). List TWO sources of obtaining large volumes of hydrogen for industrial use.

(i) Electrolysis of acidified water   (½ mk)

(ii)Cracking of hydrocarbons   (½ mk)

Steam over carbon \hydrocarbon

(c) Write equation for Haber process.   (1 mark)

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

                    Fe

 (d) Name the catalysts for:

(i) Haber process Finely divided iron   (½mk)

(ii) Contact process Vanadium (IV) oxide\platinised astestos   (½ mk)

(e) Identify substances:

(i) D <u>Ammonium sulphate /(NH$_4$)$_2$SO$_4$</u>   (½ mk)

(ii) C <u>oleum, /H$_2$S$_2$O$_7$</u>   (½ mk)
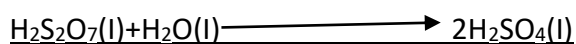
(f) Give ONE major use of compound D   (1 mark)

<u>Fertilizers</u>

(g) Write an equation for dilution of C with water.   (1 mark)

<u>H$_2$S$_2$O$_7$(l)+H$_2$O(l) $\longrightarrow$ 2H$_2$SO$_4$(l)</u>

h) A farmer has three plots each measuring 0.25 acres. He applied nitrogenous fertilizers as follows.

-plot A 250 kg of ammonium phosphate

-plot B 250 kg of urea CO(NH$_2$)$_2$
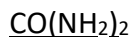
- Plot C 250kg of ammonium nitrate

Which plot received the highest nitrogen content?   (3 marks)

H = 1,   N = 14, 0 = 16.   P = 31, C = 12.

<u>42/149*100=28.19</u>

<u>CO(NH$_2$)$_2$</u>

<u>28/60*100=46.67</u>

<u>28/80*100=35</u>

<u>CO(NH$_2$)$_2$-has a highest % of Nitrogen</u>

5. h) A farmer has three plots each measuring 0.25 acres. He applied nitrogenous fertilizers as follows.

- Plot A 250 kg of ammonium phosphate   - Plot B 250 kg of urea $CO(NH_2)_2$

- Plot C 250kg of ammonium nitrate   -($H = 1$, $N = 14$, $O = 16$, $P = 31$, $C = 12$).

Which plot received the highest nitrogen content?   (3mks)

Ammonium phosphate

$$\frac{42}{149} \times 100\% = 28.19\%$$

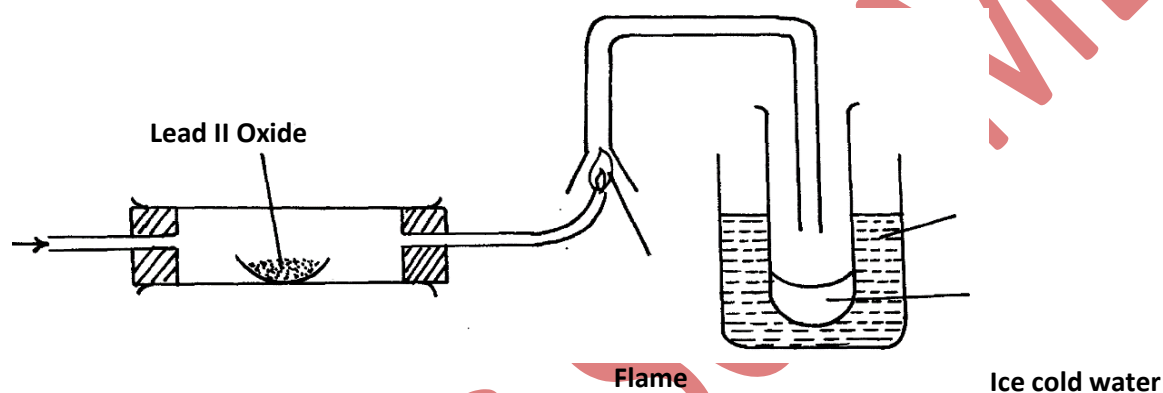*Urea* $\frac{28}{60} \times 100\% = 46.67\%$

Ammonium nitrate

$$\frac{28}{80} \times 100\% = 35\%$$

Plot B   Accept if kg are used instead of %.

6. Study the diagram below and answer the questions which follow.

Lead II Oxide

Flame   **Ice cold water**

Liquid M

(i) State **two** observations made when dry hydrogen gas pass over hot Lead (II)   oxide.
(2marks)

- Lead (II) oxide changes colour from orange to grey.

- Droplets of a colourless liquid form on cool sides of the combustion tube.

(ii) Write the equation for the reaction which occurs in the combustion tube.   (1mark)

$PbO_{(s)} + H_{2\ (g)} \rightarrow Pb_{(s)} + H_2O_{(l)}$

(iii) What property of hydrogen is shown in the experiment above   (1mark)

Reducing property.

(iv) Identify liquid M and describe the test for its purity   (2marks)

Water, Heat liquid M to boiling while measuring the temperature. B.P of

100^0C indicates that M is pure

(iv) What would be observed if MgO was used instead of Lead II Oxide: Explain   (2marks)

No change on MgO because H2 can not reduce MgO

(vi) What is the colour of the flame   (1mark)

Blue

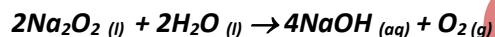(vii) Write a chemical equation of the reaction producing the flame.   (1mark)

$H_{2(g)} + O_{2(g)} \longrightarrow H_2O_{(l)}$

(vii) Apart from hydrogen peroxide, state **two** other reagents that can be used to prepare oxygen gas.   (1mark)

Sodium peroxide and water.

(viii) Write an equation to show how hydrogen gas is formed from the reagents chosen in (vii) above   (1mark)

$2Na_2O_{2 \ (l)} + 2H_2O_{\ (l)} \rightarrow 4NaOH_{\ (aq)} + O_{2 \ (g)}$

7.I. Use the data below to calculate the enthalpy change for the reaction below

$CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{\ (l)}$ (3marks)

Bond	**Energy (KJ)**
C – H	314
O = O	296
C = O	149
H – O	283

Ans = -418kJ/mol

II. Given the following Standard Molar enthalpies of combustion. Calculate the standard heat of formation of butane (C_4H_8).   (3marks)

ΔH_c^{θ} Carbon (Graphite) = -393.5KJ/mol   **(well drawn energy cycle - 2marks)**

ΔH_c^{θ} Hydrogen = -285.8KJ/mol

ΔH_c^{θ} butene = -2877KJ/mol

Ans = +159.8kJ/mol

III. Use the following information to answer the questions that follow

$\Delta H_{lattice}$ MgCl$_2$ = -2489 kJ/ mol^{-1}

$$\Delta H_{\text{hydration}} \quad Mg^{2+} = -1891 \text{ kJ/ mol}$$

$$\Delta H_{\text{hydration}}Cl^- = -384 \text{ kJ/ mol}$$

b) Using energy level diagram calculate the molar heat of solution of magnesium chloride. (4marks)

(well drawn energy level diagram - 3marks)　　　　　　*Ans = - 175kJ/mol*