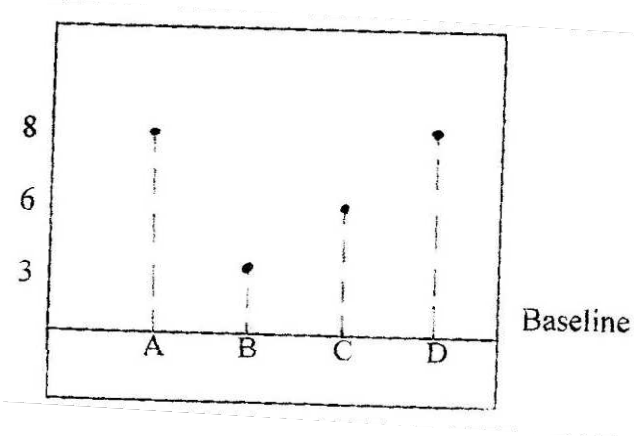
CHEMISTRY PAPER 233/2

K.C.S.E 2005 MARKING SCHEME

1. a) (i)



(ii) A and C

b) Since NH_4CL_4 sublimes but $CaCl_2$ does not ; sublimation process would do . Heat the mixture.Ammonium chloride sublimates into vapour and condenses on the cooler part of the heating tube.Calcium chloride will remain on the bottom of the heating tube.

c) i) Fractional distillation

ii) Separating funnel method

Since the tow liquids are immiscible, pour both the liquids in a separating funnel and allow to settle, the denser liquid will settle down and the less dense will form a second layer on top. Open the tape and run out the liquid in the bottom layer leaving the liquid in the second layer in the funnel.

2. a) Brine(Sodium Chloride)

b) i) $2NaOH_{(aq)} + H_2SO_4\,9_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$

2 Mol 1 Mol

ii) No. of moles of H_2SO_4 used = $\frac{40}{1000}$ x 0.5 moles

= 0.02 moles

No. of moles of NaOH = 0.02 x 2

= 0.04 moles

0.5 x 2 mole = 1.0 moles will react with 1 litre of the solution of the acid

100 cm^3 = 0.04 moles of NaOH

1000 cm^2 = $\frac{0.04 \times 1000}{100}$ = 0.4 moles

Molar mass of NaOH = 23 +16 +1

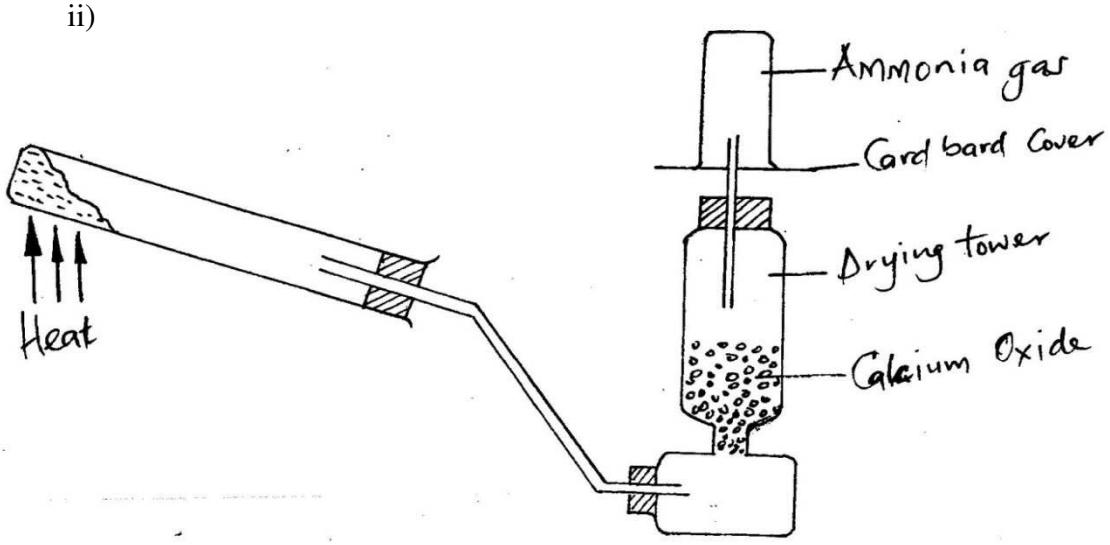
= 40

1 mole = 40

0.4 moles = 0.4 x 40
= 16g
Mass of the unreacted = 17.6 – 16
= 1.6g

c) i) M is ammonium chloride

ii)



d) i) Black Copper (II) oxide turned to reddish brown which is copper metal

ii) Ammonia acts a reducing agent.

iii) Manufacture of nitrogenous fertilizers, nitric acid, refrigerant in ships and hydrazine that is used as rocket fuel.

3. a) i) G^{2+}

ii) $G_{(s)} + H^{2+}{}_{(aq)} \rightarrow G^{2+}{}_{(aq)} + H_{(s)}$

iii) $E_o - E_R = + 0.34 - (-0.44)$
$= 0.34 + 0.44 = 0.78$ Volts

b) i) H

ii) Pure water does not contain ions or to make the water ionize

iii) Chlorine is not used because the chlorine ions will react the electrode due to its high reactivity level.

c) 144750 Coulombs = $\frac{144750 \text{ Faraday}}{96500}$
= 1.5 Faraday
2 Faraday yield = 64 g of copper
1.5 Faradays = 48 g copper

4. a) The number 52 represents mass number i.e.: the sum of the number of protons and neutrons in an atom of an element.
N = 20 = 2: 8: 8 : 2 p = 17 = 2:8:7

b) i) $N + p_2 \rightarrow Np2$

ii) P,R and S

P is a non – metal while R and S are metals, arranged in the order of S,R and P from left to right form metals (S and R) but increases from left to right for non – metal (p)

iii) S, it is a metal and is the one having the largest atomic radius which decreases from left to right for metal of the same period.

iv) p and u

C) i) I – ionic II – Metallic

ii) IV – sulphur has molecular bond which require less energy to break, hence low MP and Bp

5. a) To remove any oxide film on it i.e. layer of magnesium oxide.

b) A white solid formed which is magnesium oxide

c) The increase in mass was due to the oxygen which combines with magnesium.

d) $2Mg_{(s)} + O_{2(g)} \xrightarrow{heat} 2MgO_{(s)}$

e) The filtrate is magnesium hydroxide which is an alkaline.
There was not change in blue litmus paper but red litmus paper turned blue.
From equation in (d)

1 Mole of Magnesium atom combines with a mole of oxygen atom.
OR

	Mg	Oxygen
Mass	2.4	1.6
Molar mass	24	16
No. of moles	$\frac{2.4}{24} = 0.1$	$\frac{1.6}{16} = 0.1$ moles
Mole ratio	1	: 1

No. of moles of oxygen used = $\frac{1.6}{16} = 0.1$ moles

1 mole = $24{,}000cm^3$

0.1 mole = $24{,}000 \times 0.1$

Volume of oxygen used = $2{,}400cm^3$

6. a) i) V1 : $CH_3CH_2CH_2C(=O)-OH$ and

V3 : $CH_3CH_2CH_2C(=O)-OH$

ii) V2 : $CH_3CH_2CH = CH_2$ and V5 : $CH_3CH_2CH_2CH_3$

iii) V4 : $CH_3CH_2CH = CH_2$

It is unsaturated compound and during polymerization the double bond is broken to allow another monomer to combine.

(b)

	Advantage	Disadvantage
R – COO- Na+	They are cheaper compared to soap less detergents	Forms a scum with water containing calcium and magnesium ions
$R - SO_3 - Na^+$	They do not form scum with Ca^{2+} and Mg^{2+}	They are made from petroleum products or vegetable oils which are expensive.

(c) (i) Easters

(ii) $C_2H_4O_2(aq) + C_2H_5OH(l) \rightleftharpoons CH_3COOC_2H_3(l) + H_2O(l)$

(iii) Used as solvents

In the manufacture of drugs and chemicals

In flavouring and preservation of food

In manufacture of synthetic fibres

(iv) $2CH_3COOH(aq) + K_2CO_3(aq) \rightarrow 2CH_3COOK(aq) + CO_2(g) + H_2O(l)$

(d (i) Natural fibres include rubber, cellulose, wool, starch, silk etc.

(ii) Advantage; can be made into complicated shapes more easily, less expensive, not affected by acids. Alkalis, water and air, less dense and stronger.

7. (a) (i) graphite or titanium. They do not react with chlorine gas

(ii) A steel diaphragm is suspended between the electrodes

(iii) $2Cl^-(aq) \longrightarrow 2Cl_2(g) + 2e$

(b) (i) calcium chloride ($CaCl_2$)

(ii) It is economical i.e reducing cost of production

(c) hydrogen is preferentially discharged at the expense of sodium.

At the anode, hydroxyl ions will be prefentially discharged at expense of chlorine gas.

(d) $2Na(s) + O_2(g) \xrightarrow{\text{Limited}} Na_2O_2(s)$

$Na(s) + O_2(g) \xrightarrow{\text{Excess}} Na_2O$

(e) Making Sodium compounds e.g. Sodium Cyanide, NaCN, which is used in the extraction of gold, make lead alloy, sodium & Potassium alloy is used as a "coolant" in nuclear reactors. (Accept any two)

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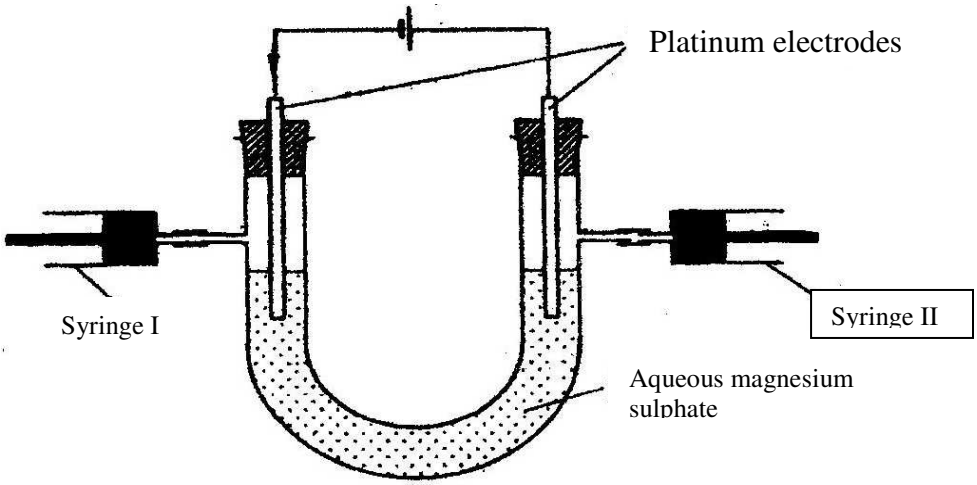
K.C.S.E 2006 MARKING SCHEME

1. a) A substance that allows the passage of an electric current and is decomposed by it. (1mk)

b) (i) Molten calcium chloride: Conducts by movement of ions. (1mk)

(ii) Graphite: Conducts by movement of ions. (1mk)

c) (i)



(ii) Syringe. 1: The H+ ions migrate to the negatively charged electrode (cathode) where they get discharged to form hydrogen gas. (1mk)

d) The amount of water used to produce O_2 and H_2 gases is **MORE** than that produced at the anode. (2mks)

e) Quantity of electricity 15 x 0.72 x 60

= 648 coulombs

$4\ OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e^-$

Faradays of electricity $\frac{648}{96500}$ = 0.0006715F

Moles of oxygen produced = 0.006715

$= \frac{0.006175}{4}$

Volume of oxygen = 0.001675x 24000

$= 40.2888 cm^3$

$= 40.29\ cm^3$ (4mks)

2. a) (i) The blue colour of solution fades. Brown solid is deposited because the coloured copper ions are discharged to form copper.(3 mks)

(ii) Heat Change

25 x4.2 x 18 = 1890 Joules (2mks)

(iii) Moles of M_g used $= \frac{0.15}{24} = 0.00625$

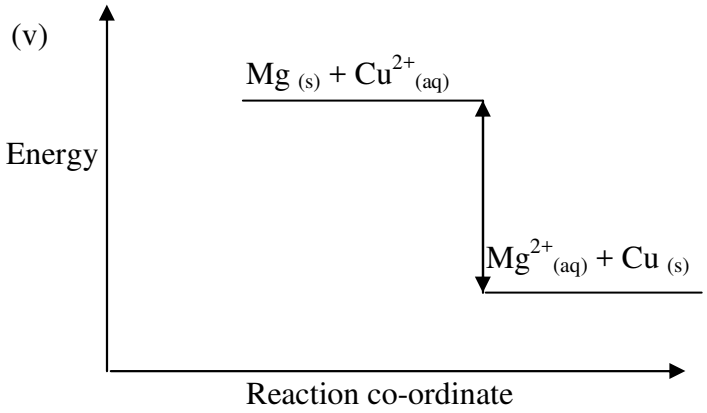
0.00625 = 1890 Joules

1 mole = $\frac{1890}{0.00625}$

= -302.4Kj mol-1 (2mks)

(iv) $Mg_{(s)} + Cu^{2+}{}_{(a}q) \longrightarrow Mg^{2+}{}_{(aq)} + CU_{(s)}$ (l) (1mk)

(v)

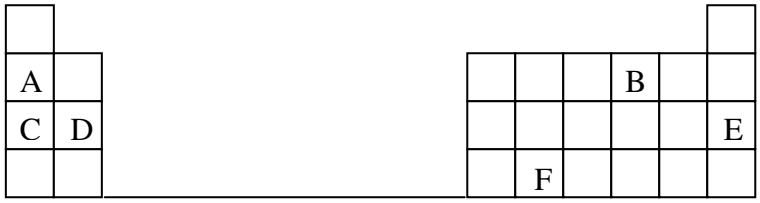


b) Zinc is higher than copper in the reactivity series of zinc is more reactive than copper or zinc will dissolve in the solution leading to weakening of the container or Redox reaction will take place. (2mks)

3. a) Isotopes are atoms with same atomic number (protons) but different mass numbers while allotropes are different forms/structure of an element in the same physical state. (2mks)

b) (i) E Atomic radius decrease across a period/E has the highest nuclear attraction/ E has the highest no. of protons. (2mks)

(ii)



(iii) used in Advertising sign Lamps/ Light /fluorescent lamps Weather/metrological/arch welding. (1mark)

(iv) $2CNO_3\,(s) \longrightarrow 2CNO_2(s) + O2_{(g)}$

$2NaNo_3(s)\,(s) \xrightarrow{Heat} 2NaNo_{2(s)} + O2_{(g)}$ (1mk)

c) Moles of chlorine used $^3/_{24} = 0.125$

Mass of Cl_2 in product formed =0.125x71 (1/2) = 8.875

Moles of D = 0.125
Mass of D 11.875-8.875 = 3g
3g
R.A.M of D = 24 (3mks)

4. a) (i) $2\ pbS_{(s)} + 3O_2(g) \longrightarrow 2PbO(s) + 2\ SO_2(g)$ (1mrk)

(ii) To avoid poisoning of the catalyst (1mk)

(iii) SO_3 is absorbed in 98% conc. Sulphuric acid to make Oleum
Or $SO_2 + H_2SO_4 \longrightarrow H_2S_2O_{7(l)}$ (1 mk)

(iv) $SO_2(g)$ and $SO_3(g)$ (1mks)

(v) They form acid rain which corrodes buildings / toxic – kills /causes respiratory problems.(1mks)

(vi) To minimize costs (mks)

b) i)

Substance	Observations
Iron filings	-Effervescence starts and stops immediately. - Bubbles of a colourless gas with a pungent smell. - A brown solution is formed (1mk)
Crystal of white sugar	- Black spongy solid(1mk)

ii) I Heating is required for conc.H_2SO_4 to react
Some SO_2 is formed /produced (1mk)

II Formation of Carbon by dehydration of sugar.(1mk)

c) $(NH_4)SO_4$ – Ammonium sulphate. (1mks)
$2CaSO_4 + Ca(H_2Po_4)_2$ Calcium super phosphate (1mk)

d) it is insoluble in water hence cannot be washed easily.(1mk)

5. a) Hydrocarbon (1mk)

b) i) Fractional distillation. (1mk)

ii) Fuel solvent / source of H_2 gas (1mk)

c) i) L = Calcuium cabide, CaC_2 (1mk)

ii) Phosphoric acid / aluminium oxide / H_2SO_4 (1mk)

iii) $H – C \equiv C – H$ (1mk)

iv) Hydrolysis or hydration or Oxidation (1mk)

iv) I
- Making rain coats.
- Plastic water pipes
- Electrical insulation
- Floor tiles. (1mk)

II Hardening of oils to form fats/ margarine manufacture(1mk)

d) i) $CH_3COOH_{(aq)} + NaOH_{(aq)} \longrightarrow CH_3CO - ONa_{(aq)} + H_2O_{(l)}$ (1mk)

ii) HCl is fully dissociated while ethanoic acid dissociates partially

$\therefore$ Ethanoic acid is weak while HCL is strong(2mks)

6. a) i) Calcium silicate / calcium aluminate (1mk)

ii) Magnetite,Fe_3O_4

Siderite,$FeCO_3$ / Iron pyrites / iron limonite

Accept both the name and or a correct formula(1mk)

iii) Carbon dioxide,CO_2 /Carbon (IV)oxide (1mk)

b) Air reacts with carbon (coke) to form carbon dioxide(CO2).Carbon dioxide reacts with coke to form carbon monoxide. The carbon monoxide reacts with Fe_2O_3 to form iron.(3mks)

c) To produce calcium oxide which reacts with silica to form slag.(1mk)

d) Cast iron is impure. (1mk)

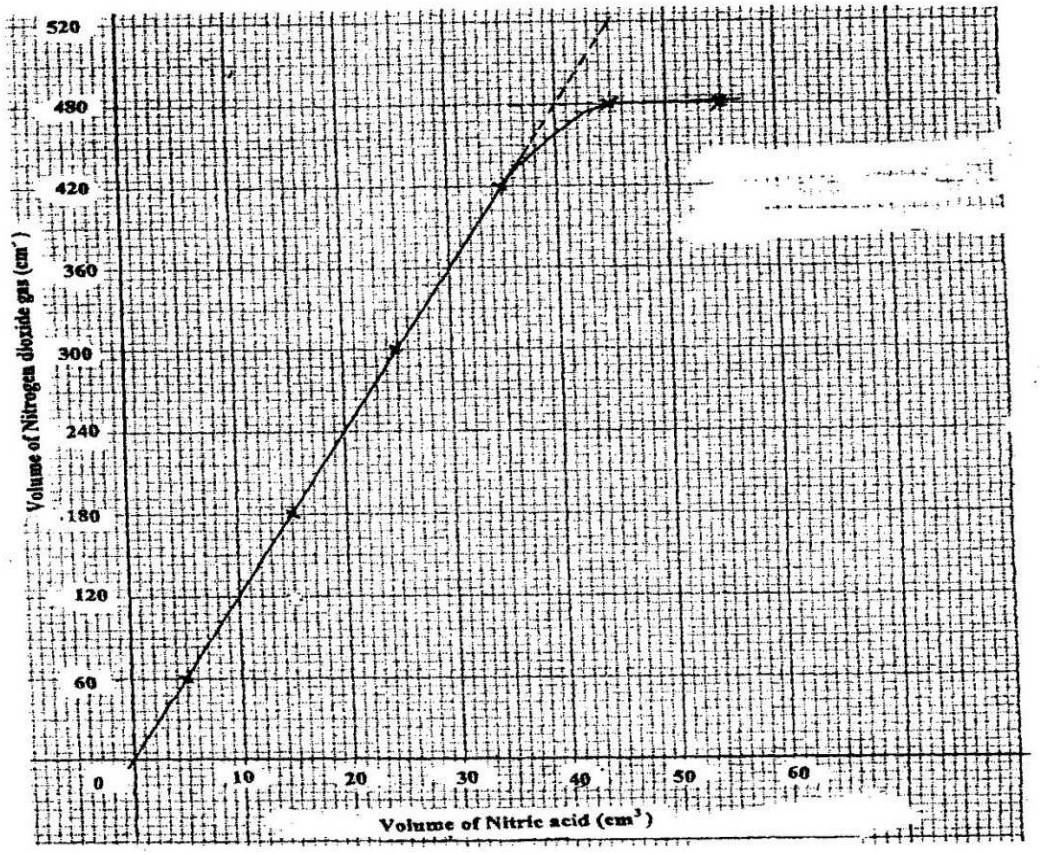
(e) Manufacture of

- Rails.
- Drainage pipes
- Engine blocks / Utensils / nails / cutlery / surgical instruments/bridges/ cars / iron sheets etc. (2mk)

7. a) Nitric acid is a strong oxidizing acid. It oxidizes hydrogen gas to water (1mk)

b) Increase Molecules acquire the necessary activation energy. This increases the frequency of collisions hence the rate of reaction.(2mk)

c)



d) i) 360 cm^3 (Correct value read from graph) (1mk)

ii) 40 cm^3 (Correct value read from graph) (1mk)

e) i) Moles of lead $= \frac{2.07}{2.07}$

$\therefore$ 1 mole of lead $= \frac{40}{0.01}$

$= 4000cm$ (2mks)

ii) $\frac{480}{0.01}$ $= 48000cm^3$ (2mks)

f) i) Moles of nitric acid $= \frac{4000}{1000}$

That react with 1 mole of lead

$= 4$ (1mk)

ii) Moles of nitrogen dioxide $= \frac{48000}{24000}$

$= 2$ (1mk)

g) $Pb_{(s)} + 4HNO_{3(aq)} \longrightarrow pb(NO_3)_{2(aq)} + 2H_2O_{(l)} + 2NO_{2(g)}$

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K.C.S.E 2007 MARKING SCHEME

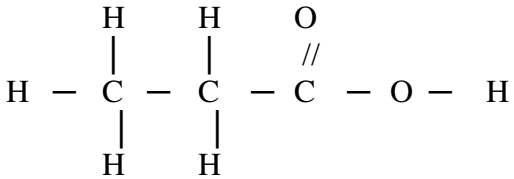
1. (a) The type of flame produced
- Amount of heat produced

(b) (i) Heat produced = MCΔT
$\Delta T = 46.5 = 25 = 21.5^0C$
$\Delta H = 450 \times 21.5 = 40635$ Joules
(ii) Moles of ethanol = $\frac{1.5}{46} = 0.0326$
Molar heat = $\frac{40635}{0.0326}$ = 1246472.392 Joules
(c) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$
(aq) (g) (L)
(d) - Heat less by radiation, conduction and convectional current
- Experimental errors when reading thermometer

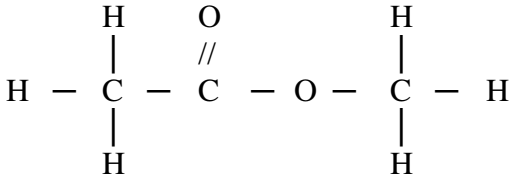
2. (a) (i) 2-Methyl – Prop – i – ene
Pent – I – yne
(b) (i) Change from orange to green
(ii) Effervescence and a colourless gas which burn with a 'pop' sound produced

(c) **Step 1**
Fermentation: Glucose solution is mixed with yeast. The enzyme zymase from yeast converts glucose to ethanol
Step II
Dehydration: Ethanol is mixed with concentrated sulphuric acid and heated in presence of Al_2O_3 as a catalyst

(d)



(ii)



(e) Produced CO_2 which causes global warming
Produces acidic – compounds which causes acidic rain

3. (a) (i) Effervescence and brown gas produced
Blue solution formed
(ii) Dilute HCL is not an oxidizing agent

(iii) 1 $CU(s) + 4HN)_3(aq) \longrightarrow CU(NO_3(aq) + 2NO_2(g) + 2H_2O(l)$
II moles of Cu= $\frac{0.5}{63.5} = 0.007874$
Moles of $HNO_3 = 0.0067874 \times 4 = 0.31496$
Volume of $HNO_3 = \frac{0.031496 \times 1000}{3} = 10.49cm^3$

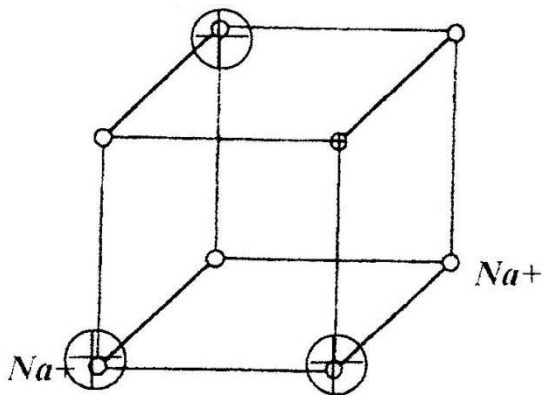
(b) Step 4 - Neutralization
Step 5 – Displacement

(c) Resistant to corrosion
It is tough, 1 strong metal

4. (a) (i) Forward reaction is faster than the reverse reaction
(ii) 1 production will reduce since equilibrium will shift backward so as to raise the pressure.
II No change in amount of methanol since a catalyst will help reaction to come to equilibrium
(iii) I Negative: the reaction is exothermic since it require low temperature to be fast.
II To ensure that the reacting particles posses more activation energy.

(b) (i) no. of seconds = 2 x 60 = 120 Sec
Moles of H_20_2 decomposed
$= 120 \times 6.0 \times 10^8 = 7{,}20 \times 10^{-6}$
Concentration of H_2O_2 may be higher since concentration increases the rate of reaction.

5.



(ii) The ions are not free at 25^0C since the salt is in solid state but between 801^0C and 1413^0C the ions are free since electrostatic forces between the ions is overcomed

(b) Ammonia react with water to form ammonia solution

(c) Dative/ co-ordinate bond

(d) Allotropes

(ii) Add salt to methylbenzene, fullerene dissolves. Filter the mixture to remove the residue. Heat the Filtrate to make it concentrated cool the solution slowly to get crystals.

(iii) $12n = 720$: $n = \frac{720}{12} = 60$

$M.f = C_{60}$

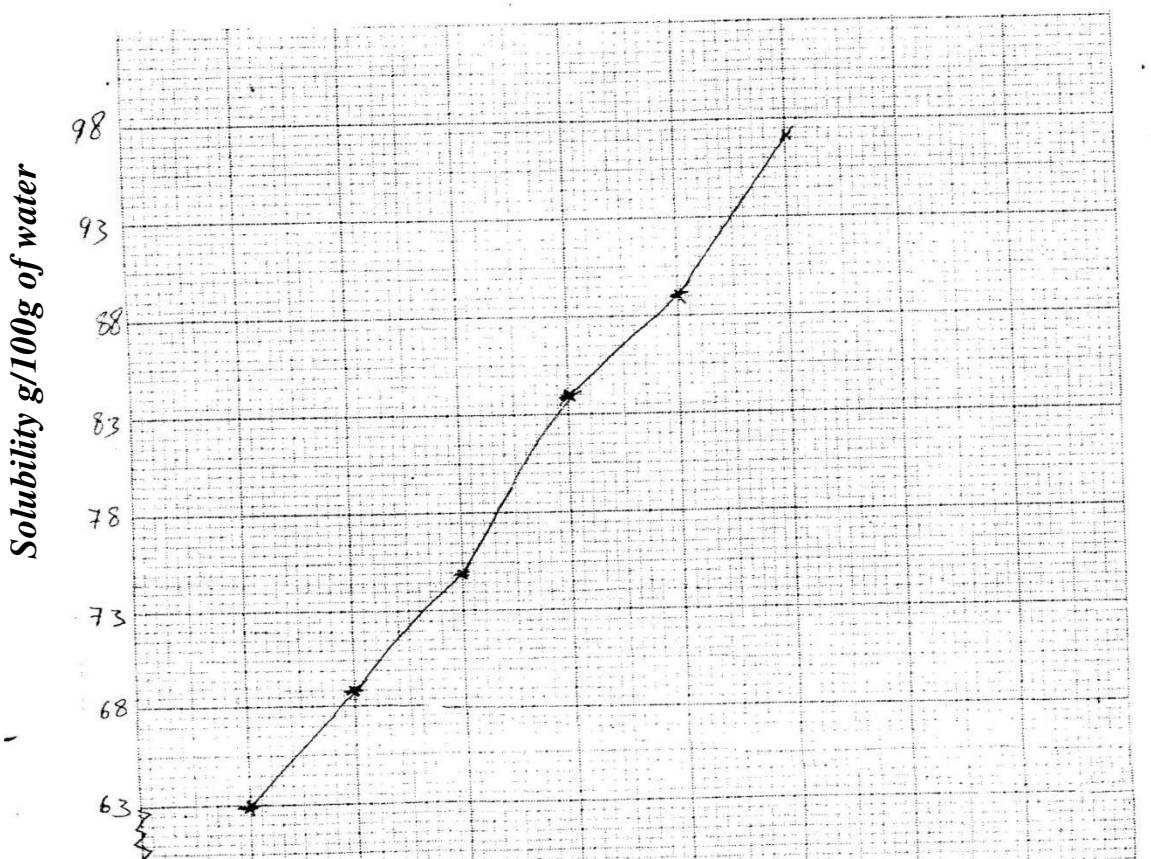
6. (a) (i) To the mixture in test tube and fresh prepared iron (II) sulphate solution. Then add concentrated sulphuric acid to form a brown ring.

(ii) RMM of $(NH_4)_2 HPO_4 = 132$

Percentage of (N) = $\frac{28 \times 100}{132} = 21.212\%$

Mass of (N) = $\frac{21.212 \times 25}{100} = 5.303$kg

(b) (i)



(ii) 71g/100mm of water

(iii) I a solution which has dissolved a lot of solute till it can dissolve no more

II Mass of solution at $25^0C = 100 + 71 = 17g$

Mass in (g) $= \frac{1000 \times 71}{171} = 41.52g$

(c) I Put soil in water in a beaker. To the mixture add a universal indicator compare the colour change to the pH chart

II Addition nitrogenic fertilizers which are acidic

7. (a) Carry experiment in a fume cupboard

Chlorine should not be allowed to escape to the atmosphere

(b) Mno_2 or $K_2Cl_2O_7$

(c) General chlorine and drive out air which may combine with heat aluminium foil

(d) Aluminium chloride sublimes when heated

(e) (i) $2AI(s) + 3Cl(g) \rightarrow 2AlCl_3(s)$

Moles of Al $= \frac{1.08}{27} = 0.04$

Moles of $Cl_2 = \frac{0.04 \times 3}{2} = 0.6$

Mass of $Cl_2 = 0.06 \times 71 = 4.26g$

(iii) $\frac{3.47 \times 100}{4.26} = 81.45\%$

(f) Pass the vapor of phosphorous trichloride through a lie big condenser to condense it.

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K.C.S.E 2008 MARKING SCHEME

1. (a) (i) Contain methane which is a fuel/ methane can burn/ flammable

(ii) Pass a weigh a known volume of biogas (VI) through dissolved NaOH or KOH/ Ca $(OH)_{2\ CO2}$ will be observed
Or CH_4 will not be absorbed – measure volume (v_2)
CH_4 $\frac{\text{Volume methane}}{\text{Volume of biogas}}$ x 100

(b) (i) Mass = KH4 = $\frac{35.2 \times 1000}{1000}$ = 1.76 kg

No. of moles methane $= \frac{35.2 \times 5 \times 1000}{100 \times 16}$

Mass kg = 1.76 x 1000
= 1760 g

Molar of methane = $\frac{1760}{16}$
=110 moles

(ii) $CH_4 + 20_2 \rightarrow CO_2 + H_2O$
110 x 24 = 2,640

(c) (i) Global warning
(ii) I Ammonium nitrate
II Aerosols, Propellant, Freons

2. (a) (i) $2\ KNO_3(l) \xrightarrow{heat} 2KNO_2(l) + 0_2(g)$

(ii) $2\ AgNO_3(s) \xrightarrow{heat} 2\ Ag(s) + 2NO_2(g) + O_2(g)$

(b) (i) Period 2, two energy levels
(ii) A2 has greater atomic number than A1
A2 has greater nucleus charge than A1
A2 has more protons than A1
Therefore
I Across the period from left to right nuclear charge, exert greater pull on Electrons hence reduction in size.
II A4 gains electrons, incoming electron is repelled by existing electrons, electrons cloud increases.

(iii) A2

(iv) 

3. (a) - Filter the air/ electrostatic precipitation/ Purify the air
- Pass air through NaOH in KOH to remove CO_2
- Cool to remove to remove water vapour
- Cool the remaining gases from a liquid air
- Perform fractural distillation of liquid air
- Nitrogen is collected at – 196^0 C

(b) (i) Nitrogen II Oxide (NO)

(ii) $4_{-3}NH_3\,(g) + 3\,CUO \rightarrow 2N_2\,(g) + 3H_2O(l) + 3\,Cu$
Oxidation no of N in ammonia increases from -3 to 0
Oxidation number of reducing agent increases
Oxidation number Cu decreases from + 2 to O hence an oxidizing agent
Ammonia is a reducing agent

(iii) $NH_4NO_3(s)$ or $(aq) \rightarrow N_2O(g) + 2H_2O(g \text{ or } l)$

(iv) Fertilizer/explosive

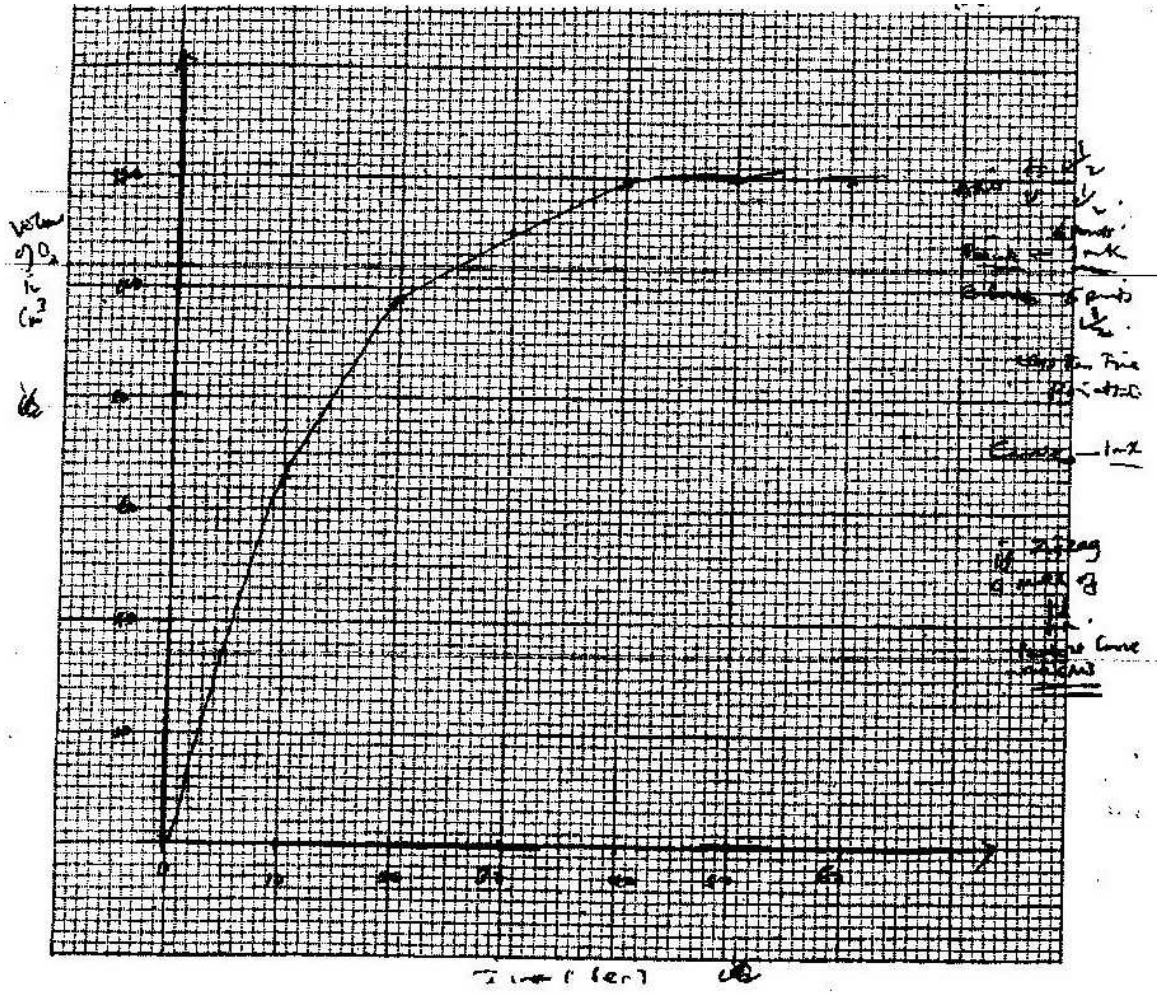
(c) (i) G or G^{2+}

(ii) $E^{2+}(ag) + 2OH_{(ag)} \rightarrow E\,(OH)_2(s)$

4. (a) (i) When change is made to a system in equilibrium the
System moves so as to oppose the change.
(ii) Pressure has no effect to equilibrium
The moles/Volume/ molecules of gases is reactants and product are equal
(iii) DH –ve (negative)
Since lowering of temperature moves to equilibrium to direction which heat is produced. Decrease in temperature favours exothermic reaction

(b) (i) Manganese IV oxide

(ii) Graph



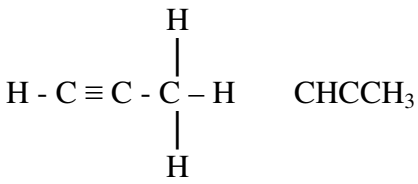
(iii) Drawing tangent at any time above 24 sec/ between 24th sec and 40 sec, correct use of tangent to calculate rate.

Or

Average rate after 24th sec = $\frac{\text{value of } O_2 \text{ at 24 sec}}{\text{Time at which the graph levels}}$

(iv) The reactants has been used up

5. (a)



$CHCCH_3$

(b) (i) Heat temperature ≥ 400k
Catalyst temperature ≥ 700k

(ii) Ethane, CH_3CH_3, C_2H_6

(iii) I Pollutes environment / produces poisonous gases when burnt.

II Hydrolysis
- Hydrogen
- Oxidation
- Addition

III Ethyl propenoeate
$CH_3CH_2C\text{-}O\text{-}CH_2CH_3$ $C_5H_{10}O_2$

(iv) Calculations of empirical formula mass = 28

$$\frac{16800}{28} = 600$$

(c) (i) M or C_3H_6
M is unsaturated / M is an alkene/ carbon dioxide bond

(ii) N is an acidic compound/ alkanoic acid

6. (a) (i) OH^- migrate to anode, OH^- discharged to form oxygen or equation

$4OH^-(ag) \rightarrow 2\ H_2O\ (l) + O_2\ (g) + 4e^-$

OH oxidized to produce oxygen gas.

(ii) Copper anode would dissolve to give CU^{2+}
Oxidation of copper in pure energetically favorable than oxidation hydroxide ions

(b) (i) Copper pyrite
Malasclite
Cuprite
Chalco Pyrite

(ii) $CU^{2+}(ag) + 2e^- \rightarrow Cu(s)$

(iii) Q= IT
0.5 x 18 x 16 = 540c
0.5 x 18 x 60 = 540c

$$\frac{108 \times 540}{96500} \qquad \frac{540}{96500} = 0005596$$

$$\frac{0.005596 \times 108}{1} = 0.60g$$

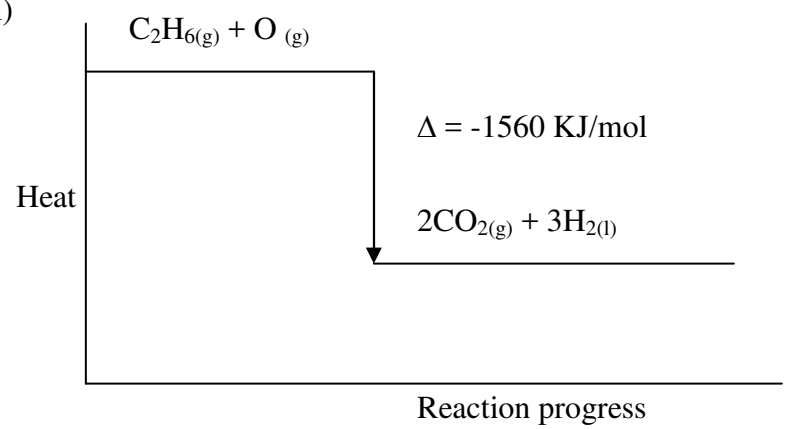
(iv) Prevent corrosion

Decoration/ improve appearance
Prevent turning of metals

7. (a) The heat change when mole of substance is formed from its constituent elements.

(b) (i) Heat of combustion of hydrogen
Heat of formation of water stream

(ii)



(iii) $2CO_2 + N_3H_2O_{(l)} \rightarrow C_2HI_{(g)} + {}^{7}/_{2}\ O_2\ \Delta H = 1560$ kj/mol

$2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_2 - 788KJ$ Multiply equation by 2

$3H_2 + {}^{3}/_{2}\ O_2 \rightarrow 3\ H_2O_{(g)} = 858$ KJ

$2C_{(s)} + 3H_2 \rightarrow C_2H_{6(g)} - 86$ KJ/mol

(iv) Heat produced $= \frac{500 \times 21.5 \times 4.3}{1000}$

$= 45.15$ KJ

II Moles of ethane $= \frac{\text{Answer I}}{1560}$

$= {}^{45..15}/_{1560}$

$= 0.02894 \times 39$
$= 0.868$

K.C.S.E 2009 CHEMISTRY PAPER 2

MARKING SCHEME

1. (a) (i) $MnO_2 + 4HCl\ (aq) \longrightarrow MnCl_2\ (aq) + Cl_2(g) + 2\ H_2O(g)$

(ii) $KMnO_4$ / $CaOCl_2$ (aq) /PbO_2

(iii) Passing it through a U- tube containing dehydration calcium chloride (CaCl)

- Passing Chlorine gas through concentrated sulphuric acid in a flask.

(b) (i) Aluminium chloride – $AlCl_3$

(ii) $2Al(s) + 3\ Cl_2\ (g) \rightarrow 2\ AlCl_3(g)$

(iii) Moles of Al metal used = $\frac{0.84}{27}$

= 0.0311

Moles of Cl_2 gas = 0.0311 x 3/2

= 0.047

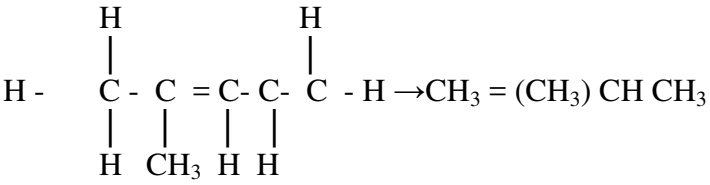
Vol of Cl_2 gas = 0.047 x 24

= 1.12 dm^3

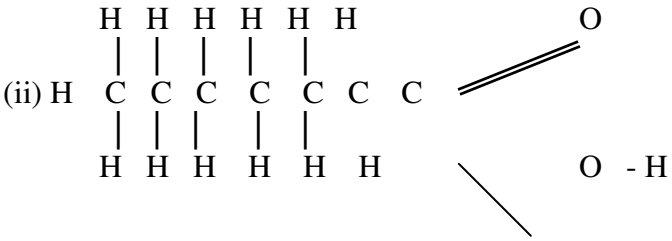
(iv)

- Prevent water moisture from entering the apparatus/ absorbing
- React with excess Chlorine/ prevent environmental pollution
- Prevent hydrolysis of Aluminium Chloride

2. (a) (i) 2 – methyl vut – 2- ene;



(ii)



$CH_3CH_2CH_2\ CH_2\ CH_2\ C$ (double bond) O

(single bond) O - H

(b)

- Determine the boiling points/ temperature of the two alkanols. Hexamol has a higher boiling point temperature.
- Add equal amounts of water to each pollow of alkanol and shake for hexanol, two layers of liquids are formed while for methanol a homogeneous solution is formed.
- Determine the density of the two alkanols. Hexanol is denser than methanol
- Refractive index, hexanol has a higher refractive index

(c) (i) (l) Esterification accept condensation
(ll) Cloroethane / $CH_3\ CH_2\ Cl/C_2\ H_sCl$

(ii) $CH_3\ CH_2ONa\ C_2H_5ONa$
(iii) Hydrogen gas
High temperature ($150^0 – 250^0C$) *Reject unspecified conditions*
High pressure (200 – 250 atm)
2 mks for any 2 conditions tied to correct reagent
Nickel catalyst

3. (i) $D(l)^{2+} + 2e^- \rightarrow D\ (S)$ (1 mk)

(ii) $2B+^-\ (l) \rightarrow Br_2\ (g) + 2e^-$ (-1/2 for wrong/ missing)

(ii) Carbon Graphite
It will not be attacked by/ react Bromine gas & D reacts with bromine vapours
(iii) Chlorine gas is poisonous/ toxic gas
(iv) (I) weigh the cathode before the start of the expt
Weigh cathode after the experiment / 90 minutes get the differences in weights
(II) Q = It $Q = 0.4 \times 90 \times 60 = 2160C$ RAM = $\frac{2.31 \times 96500}{2160}$ ½ mk
1 mole of D = 96500
$2.31 = 2160 \times \frac{RAM}{2 \times 96500}$ = 206.4 ½ mk

4. (a) (i) Channel / pump sea water into shallow ponds. Evaporation of water occur at the ponds sodium Chloride crystallizes out.
(ii) 1. $NH_3(g) + CO_2\ (g) + H_2O\ (w) \rightarrow NH_4HCO_3(aq)$
2. $NH_4HCO_3(aq) + NaCl\ (aq) \rightarrow NaHCO_2(s) + NH_4\ Cl(aq)$
(iii)
1. Filtration

2. Heating

(iv) I. $NaCO_3$ (s) + H_2 SO_4 (aq) → N_aSO_4 (aq) + CO_2 (g) + H_2O (l)

Moles of H_2SO_4 = 40 x 0.5
1,000
= 0.02

Moles of Na_2CO_3 = Moles of H_2SO_4 = 0.02

Mass of Na_2CO_3 = 0.02 x 106

2.12 (g)

Percentage purity = (2.12 x 100) %
2.15
= 98. 6%

II. Mass of Na_2CO_3 = 0.02 x 106
= 2.12 g

Percentage purity = (2.12 x 100%)
2 .15
= 98. 6%

b. - Used in textile industries - used in photography
- Manufacture of glass - Making anti acid drugs
- Softening hard water - In paper industries
- Making of detergents - As a food additive

5. (a)

(i) I. Condensation
II. Melting

(ii) Iodine, Benzoic acid, Camphos, Dry Ice. Solid Co_2 Naphthalene

(iii) $H_2O(g) \rightarrow H_2O(g)$

(b)

(i) Van des waals and hydrogen bonding
II Van des waals forces

(ii) I. The separation distance is smaller during fusion than during vaporization hence requires much lower energy than in vaporization and vice versa.
II. Heating time NP is far much less than heating time in QR/ Heating time

(c)

(i) Hydrogen burns to produce steam which is a non pollutant/ does not cause pollution to the environment

- Hydrogen has a high energy content hence very small amount produce a lot of heat energy
- Hydrogen is renewable hence cannot be exhausted/ used completed.

(ii) It can easily explore when burning/ highly flammable unlike fossils fuels expensive.

6. (a)

Ion	Number of protons	Number of neutrons	Mass Number	Electron arrangement
W	17 ½ mark	20	37 ½ mark	2.8.8
X4+	14	14 ½ mark	28	2.8 ½ mark

(b) (i) Sodium burns with a yellow flame & yellow white/ solid powder is formed while copper burn with a blue green flame & black powder/ silic is formed.

(ii) Sodium darts on the surface of water / rapid fast effervescence (fast production of bubbles; solution becomes pink immediately.
Magnesium sinks in water/ slow (production of bubbles) effervescence/ solution becomes pink gradually.

(c) Magnesium it has a higher nuclear charge which pulls outer electrons more strongly

(d) i. $^{238}_{920}u$ it is the most abundant

(ii) $\frac{0.01 \times 2.34 + 0,72 \times 235 + 238 \times 99.27}{100}$

$(2.34 + 169 .2 + 236.2626)/100$ ½ mk

$= \frac{23797.80}{100}$

= 237.978 ½ mk

(iii) $^{235}_{92}U \rightarrow ^{231}_{90}Th + ^{4}_{2}He$

(iv) Control thickness of paper

(a) Coke/ coal/ Charcoal/ Carbon

(b) $C_{(s)} + CO_2\ (g) \rightarrow 2\ CO_{(g)}$

(c) The reaction between coke/ coal and the hot air is highly exothermic

(d) Slog is immiscible with molten iron

(e) Nitrogen (iv) oxide gas forms acid rain. Which corrodes metallic materials and destroys vegetation the environment.

(f) (i) By passing/ blowing oxygen into molten iron which converts carbon into carbon

(iv) Oxide

(ii) To increase the tensile strength/ making the iron less brittle/ making it more malleable / making it more ductile.

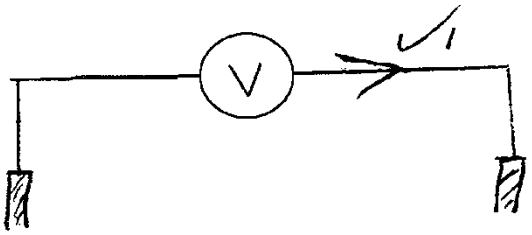
CHEMISTRY PAPER 233/2

K.C.S.E 2010 MARKING SCHEME

1 a) - Ammonia or Copper (II) Chloride

- This is because they forms ions or ionize when they dissolve in water

b) i)



ii) Potassium nitrate, potassium chloride, sodium nitrate, sodium chloride, potassium sulphate, sodium sulphate

c) i) - Improve appearance/ beautify

- To prevent rusting/ corrosion

ii) 108 x (0.5 x 60 x 60)

1 x 96500

= 2.01g

2 a) i) - 2, 2-diamethylpropane

- Dimethylpropane

ii) Pent-2-yne

b) Add acidified KMNO4 or bromine water or to each of the compounds in separate lesflukes

i) Does not decolourise the reagents

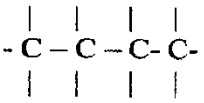
ii) Decolorizes the reagents or

- Burn each one of them
- Burns with a blue flame/ non litmus flame
- Burns with a yellow/ sooty/ luminous flame

c) I) $CH_3C(=O)-O-CH_2CH_3$ / Ethylethanoate

II) CH_3CH_3 / Ethane

ii)



iii) - Water/ steam – Reagents

4 a) i) - B >A> Cu> C or C< CU<A<B

- B is the most reactive because it has the highest ΔT
- C is the least reactive because it cannot displace copper ions
- A is more reactive than copper because it can displace its ions

ii) - Blue colour disappears or a brown deposit formed

b i) $C(s) + 2H_2(g) + ½ O_2g \longrightarrow CH_3OH(l)$ $\Delta H = -239\ Kjmol^{-1}$

ii) I) Yield increases when pressure is increased, the molecules are brought closer to one another OR frequency of high energy collisions increases OR forward rxn is accompanied by decrease in volume.

Eqim shifts to the right // forward rxn is favored by an increase in pressure.

II) $CO(g) + ½ O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -283\ kJmol^{-1}$

$2H_2(g (+ O_2(g) \longrightarrow 2H_2O(l)$; $\Delta H = -572\ kJmol^{-1}$

$CO_2(g) + 2H_2O(l) \longrightarrow CH_3OH(l) + {}^3/_2\ O_2(g) = 715\ kJmol^{-1}$

Change in energy = 715 – 283 – 572

= -140

iii) - This is due to heat lost to surrounding

- Incomplete reaction
- Enthalpy of formation of CO not included

5a) I) - Flask should be slanting downwards left to right

- The water produced may crack the flask

II) - Method of collection of gas wrong

- Ammonia is less dense than the air
- Reagents used are must
- Ammonia gas will dissolve

ii) CaO

iii) $Ca(OH)_2(s) + 2NH_4Cl(g) \longrightarrow CaCl_2(aq) + H_2O(l) + 2NH_3(g)$

iv) - Pass dry HCL through ammonia

- Mixture forms dense white fumes
- Dip a glass rod into conc: HCl acid and then place on the gas jar containing NH3 gas. Dense white fumes formed

b) i) UNIT I

ii) NO / nitrogen (II) oxide

NO_2 / Nitrogen (IV) Oxide or NO.

iii) Nitrogen in NH_3 = -3

Nitrogen in $HNO_3 = +5$

- Increase in oxidation number / state is oxidation

iv) $NH_3(g) + HNO_3(aq) \longrightarrow NH4NO3$

Molar mass $NH_4NO_3 = 80g$

Moles of $NH_4NO_3 = \frac{1000 \times 1000}{80}$

Moles of $HNO_3 = \frac{1000 \times 1000}{80}$

Molar mass of 63

Mass of $HNO_3 = \frac{1000 \times 1000 \times 62}{80}$

$= 787.5kg$

OR

$\frac{1000 \times 63}{80} = 787.5k$

6 a i) ZnS

ii) So as to obtain ZnO which is easily reduced by CO to Zn

$2ZnS(s) + 3O_2(g) \longrightarrow 2ZnO(s) + 2SO_2(g)$

b) i) - Coke / Carbon

- Limestone ($CaCO_3$)

ii) $2C(s) + O_2(g) \longrightarrow 2CO(g)$

$2CO_2(g) + C(S) \longrightarrow 2CO(g)$

iii) - Vapour

- The furnace temp is above the B/pt of Zinc

iv) - $420 - 906^0C$

- It is condensing // or the temperature is below the B/pt of Zinc

v) Prodin of SO_2 - It is poisonous // acedicram that corrode buildings // kill aquatic life

- Gullies becomes reservoir of water where breeding of mosquitoes takes place / people can be drown
- $CO(g)$ – Poisonous
- CO_2 / global warming

vi) - Making brass

- Used as negative terminal in dry cell / used in dry cells
- Galvanizing of iron sheets

7 a) i) - Curve I

- The concentration of products are increasing

Nitrogen in $HNO_3 = +5$

- Increase in oxidation number / state is oxidation

iv) $NH_3(g) + HNO_3(aq) \longrightarrow NH4NO3$

Molar mass $NH_4NO_3 = 80g$

Moles of $NH_4NO_3 = \frac{1000 \times 1000}{80}$

Moles of $HNO_3 = \frac{1000 \times 1000}{80}$

Molar mass of 63

Mass of $HNO_3 = \frac{1000 \times 1000 \times 62}{80}$

$= 787.5kg$

OR

$\frac{1000 \times 63}{80} = 787.5k$

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- CO_2 / global warming

vi) - Making brass

- Used as negative terminal in dry cell / used in dry cells
- Galvanizing of iron sheets

7 a) i) - Curve I

- The concentration of products are increasing

CHEMISTRY PAPER 233/2

K.C.S.E 2011 MARKING SCHEME

1. The flow chart below shows some of the processes involved in large scale production of sulphuric (IV) acid. Use it to answer the question that follow.

(a) Describe how oxygen is obtained from air on a large scale (3 marks)
Purity to remove impurities, bubble through NaoH/KoH to remove CO_2, reduce the temp, to remove water vapor compress to liquefy the residual air, then fractional distillation to obtain oxygen at -183^0C

(b) (i) Name substance A. (1 mark)
Concentrated sulphuric
(vi) acid
(ii) Write an equation for the process that takes place in the absorption chamber (1 mark)
$SO_{3(g)} + H_2SO_{4(l)} \_ H_2S_2O_{7(l)}$

(c) Vanadium (V) oxide is a commonly used catalyst in the contact process.
(i) Name another catalyst which can be used for this process. (1 mark)
Platinum/platinum asbestos
(ii) Give two reasons why vanadium (V) oxide is the commonly used catalyst
It is cheap/cheaper (2 marks)
Not easily poisoned/action stopped by impurities

(d) State and explain the observation made when concentrated sulphuric (VI) acid is added to crystals of copper (II) sulphate in a beaker. (2 marks)

Turns blue & white. Forms white powder sulphuric (VI) acid dehydrates copper(II) sulphate crystals/ remove water of crystallization.

(e) The reaction of concentrated sulphuric (VI) acid with sodium Chloride produces hydrogen chloride gas. State the property of concentrated sulphuric (VI) acid illustrated in this reaction.
It is less volatile/volatility / involatile

(f) Name four uses of sulphuric (VI) acid. (2 marks)
Manufacture of sulphate fertilizer/superphosphate fertilizer/production of Ray on making dyes/used in car batteries/ As an electroly manufacture of sosaples detergents/cleaning of metals manufacture of pain HCL/HNO_3/Oleum.

As a drying agent, as adehydrating agent/manufacture of nylon AL_2SO_4/$ALCOH_3$/sulphate drugs, pigments

2. The set-up below was used by student to investigate the products formed when aqueous copper

3. (II) chloride was electrolysed using carbon electrodes.
   (a) (i) Write the equation for the reaction that takes place at the cathode.(1 mark)
   $CU^{2+}{}_{(G)} + 2E \longrightarrow CU_{(S)}$
   (II) Name and describe a chemical test for the product initially formed at the anode when a highly concentrated solution of copper (II) chloride is electrolysed.(3 marks)
   Chlorine gas

   Moist blue litmus paper/fresh or moist coloured petals/ change from blue to white/
   (III) How would the mass of the anode change if the carbon anode was replaced with copper metal? Explain. (2 marks)
   Decrease the anode is not inert so l+ dissolves/reacts/iodine oxidized

   (b) 0.6 g of metal B were deposited when a current of 0.45 A was passed through an electrolyte for 72 minutes. Determine the charge on the ion of metal B.
   (Relative atomic mass of B=59, 1 Faraday = 96 500 coulombs) (3 marks)

   (c) The electrode potentials for cadmium and Zinc are given below:
   $Cd2+ (aq) + 2e \longrightarrow Cd (s)$; $E^{\ominus} = - 0.4v$
   $Zn2+ (aq) + 2e \longrightarrow Zn(s)$; $E^{\ominus} = - 0.76v$

   Why is it not advisable to store a solution of cadmium nitrate in a container made of Zinc. (2 marks)

   Zinc reacts with cadmium ions/displaces/cadmium ions/Zinc container dissolve because Zinc is more reactive/Electropositive than calmium or calculate
   Zn is a stronger reducing /Zinc is oxidized

4. (a) Ethanol can be manufactured from ethane and steam as shown in the equation below:
   $C_2H_{4(g)} + H_2O (g) \longrightarrow CH_3CH_2OH_{(g)}$

   Temperature and pressure will affect the position of equilibrium of the above reaction.
   Name the other factor that will affect the position of equilibrium of the above reaction.
   Concentration/volume

(b) The data table below was recorded when one mole of ethane was reacted with excess steam. The amount of ethanol in the equilibrium mixture was recorded under different conditions of temperature and pressure. Use the data to answer the questions that follow.

Temperature (^{0}C)	Pressure (Atm)	Amount of ethanol at Equilibrium (Moles)
300	50	0.40
300	60	0.46
300	70	0.55
250	50	0.42
350	50	0.38

(i) State whether the reaction between ethane and steam is exothermine or endothermic. Explain your answer. (3 marks)
Exothermic I increased in temp at constant pressure. The amount of ethabol formed at eqm decreases and vise versa decrease in temp at

(ii) State and explain one advantage and one disadvantage of using extremely high pressure in this reaction. (2 marks)

I. Advantage
Amount of ethanol increases, pressure favours the side with less molesle products/egm shifts to the right/forward rxn is favoured.

II. Disadvantage
It would be expensive/uneconomical. The cost would go up or maintaining / high pressure is costly. Explosion can occur hence costs will go up
It's costly to maintain high pressure

(c) In an experiment to determine the rate of reaction between calcium carbonate and hydrochloric acid,2g of calcium carbonate were reacted With excess 2 M hydrochloric acid. The volume of carbon (IV) oxide evolved was recorded at regular intervals of one minute for six minutes. The results are shown in the table below.

Time (minutes)	1	2	3	4	5	6

Volume of carbon (IV) oxide (cm^3)	170	296	405	465	480	480

(i) Plot a graph of time in minutes on the horizontal axis against volume of carbon (IV) oxide on the vertical axis. (3 marks)

(ii) Determine the rate of reaction at 4 minutes. (2 marks)
Drawing targent
Rate = $\frac{Y_2-Y_1}{X_2-X_1}$ = Ans CM^3/Min

5. (a) when excess calcium metal was added to 50 cm^3 of 2 M aqueous copper(II) nitrate in a beaker, a brown solid and bubbles of gas were observed.

6.

(i) Write two equation for the reactions which occurred in the beaker. (2 marks)
$Ca(s) + CU^{2+}(aq) \longrightarrow Ca^{2+}(aq) + CU(s)$
$Ca(s) + Cu(NO_3)_2(aq) \longrightarrow Ca(No_3)_2(aq) + Cu(s)$
$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$

(ii) Explain why it is not advisable to use sodium metal for this reaction. (2 marls)
The reaction is highly explosive/highly exothermic because sodium is more reactive than calcium.
Na is more electro positive than calcium.

(c) Calculate the mass of calcium metal which reacted with copper (II) nitrate solution. (relative atomic mass of Ca=40) (2 marks)
No of moles of = $50/_{1000}$ x 2
Copper (ii) nitrate
= 0.1 moles
Ratio 1:1
Moles of Ca = 0.1
Mass of Ca = 0.1x40
=4g

(d) The resulting mixture in (a) above was filtered and aqueous sodium hydroxide added to the filtrate dropwise until in excess. What observations were made? (1 mark)
A white ppt is formed which is insoluble in excess

(e) (i) Starting with calcium oxide, describe how a solid sample of calcium carbonate can be prepared. (3 marks)
Add Cao to dil HNo_3/Hcl/H_2O. Add Na_2CO_3/K_2CO_3/NH_4 CO_3/CO_2 a solution filter out $CaCO_3$ as residue.

(iii) Name one use of calcium carbonate.
Preparation of CO_2 in the laboratory
Manufacture of Na_2Co_3 in s process
Manufacture of Cao

7. (a) Other than their location in the atom, name two other differences between an electron and a proton. (2 marks)

Electron is negatively charged while proton is positively charged
Electron has a mass of units while proton has a mass of unit
Mass of proton is bigger that that of electron.

(b) The table below gives the number of electrons, protons and neutrons in particles A, B,C,D,E,F and G

Particular	Protons	Electrons	Neutrons
A	6	6	6
B	10	10	12
C	12	10	12
D	6	6	8
E	13	10	14
F	17	17	18
G	8	10	8

(i) Which particle is likely to be a halogen? (1 mark)
- F

(ii) What is the mass number of E? (1 mark)
- 27

(iii) Write the formula of the compound formed when E combines with G.
- $E_2 G_3$/$AL_2 O_3$

(iv) Name the type of bond formed in (iii) above. (1 mark)
- Ionic bend/electrovalent

(v) How does the radii of C and E compare? Give a reason. (2 marks)
E has smaller atom in radius that C or Vice versa

E has more protons that C/nuclear attract stronger

(vi) Draw a dot (.) and cross (x) diagram for the compound formed between A and F.

(vii) Why would particle B not react with particle D?
B is inert/has stable configuration/has octet electron in the outermost/belong groups of periodic table /has noble gas configured

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

(i) I what observation will be made in Step 1? (1 mark)
Acidified KMno4 is decolorized/change from purple to colorless.

II Describe a chemical test that can be carried out to show the identity of Compound C. (2 marks)
Add carbonate/HCO_3, effervescence is observed
Add a mixture of alkanol and conc H_2SO_4 and warm a pleasant /smell occurs

(ii) Give the names of the following: (2 marks)
I E polyethene
II substance D sodium ethoxide

(iii) Give the formula of substance B. (1 mark)
CH_2BrCH_2Br/H-C-C-H/$C_2H_4Br_2$

(iv) Name the type of reaction that occurs in: (1 marl)
I step (II) dehydration
II Step (IV) hydrogenation/Addition reaction

(v) Give the reagent and conditions necessary for Step (VI). (2 marks)
Reagent; Methanoic Acid/H CooH
Conditions: concentrated surphuric (vi) acid and warm

(b) (i) Name the following structure.

- Hexan – I –OI

(iii) Draw the structure of an isomer of pentene. (1 mark)

- $CH_3 – CH = C-CH_3- CH_3$

9. (a) What is meant by molar heat of combustion?
Amount of heat liberated/energy change when o ne mole of a substance is burnt in excess oxygen

(b) State the Hess's Law

Heat obsorbed/evolved in a chemical change is the same regardless of the route taken

(c) Use the following standard enthalpies of combustion of graphite,hydrogen and enthalpy of formation of propane.

(i) Write the equation for the formation of propane.

- $3C(s) + 4H_2(g) \longrightarrow C_3H_8(g)$

(ii) Draw an energy cycle diagram that links the heat of formation of propane with its heat of combustion and the heats of combustion of graphite and hydrogen.

(3 marks)

(iii) Calculate the standard heat of combustion of propane. (2 marks)

- DHc (C_3H_8) = HO_4 + (3x-393) + (4x-286)
  = -2219 KJ/MO1

(d) Other than the enthalpy of combustion, state one factor which should be considered when choosing a fuel.

- Cost
- Availability
- Storage
- Effect on environment
- Ease of transportation

(e) The molar enthalpies of neutralization for dilute hydrochloric acid and dilute nitric (V) acid are -57.2KJ/mol while that of ethanoic acid is -55.2kJ/mol. Explain this observation.

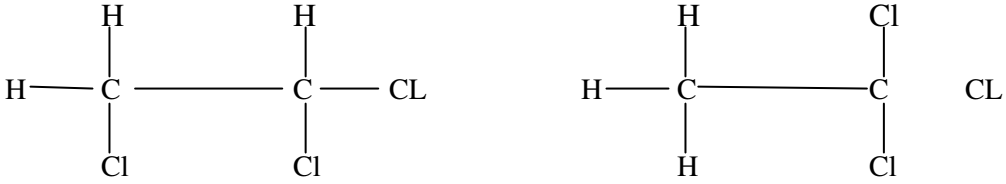
(2 marks)

- Ethanoic acid is a weak acid some heat is used to ionize before neutralization occurs.
- Ethanoic acid dissociates partially than another

CHEMISTRY PAPER 233/2

K.C.S.E 2012 MARKING SCHEME

1. a)

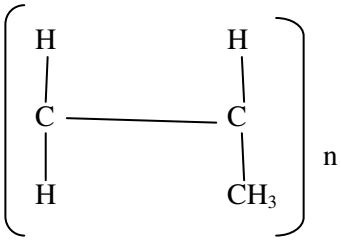


b) Add a few drops of acidified potassium dichromate with ethane the solution changes from orange to green while in ethane the solution remains orange

- Add a few drops of acidified potassium manganate with ethane solution changes from purple to clourless while in ethane the solution remains purple.

c) i) Concentrated sulphuric (VI) acid / Al_2O_3/ concentrated phosphoric (V)

ii)



iii) $Na_2CO_3 + 2CH_3CH_2COOH_{(aq)} \rightarrow 2CH_3CH_2COONa_{(aq)} + H_2O_{(l)} + C$

iv) $2C_3H_7OH_{(l)} + 9O_{2(g)} \rightarrow 6CO_{2(g)} + 8H_2O_{(l)}$

Moles of $CO_2 = \frac{18}{24}$

Moles of $CH_3CH_2CH_2OH = \frac{18}{24} \times \frac{1}{3}$

R.M.M of $CH_3CH_2CH_2OH = 60$

Mass of propan-I-OL = $\frac{18}{24} \times \frac{1}{3}$ x 60 = 15g

2. a) - Has the smallest atomic radius

- It is the most electronegative element in the periodic table
- Has the highest tendency to gain electrons
- Has the highest electron affinity.

b) i) AB_2// CO_2//AB//CO

ii) Covalent bond

c) i) Halogens

ii) $C_{2(g)} + 2H^-_{(aq)} \rightarrow 2C^-_{(aq)} + H_{2(g)}$
$F_{2(g)} + 2Br^-_{(aq)}\ 2F^-_{(aq)} \rightarrow 2F^-_{(aq)} + Br_{2(aq)}$

d) F has a giant atomic structure with strong covalent bond while G has simple molecular structure with weak van der waals forces between its molecules

e) D_2O, D_2O_2

f)
- Giant atomic structure
- Simple molecular
- Covalent bond
- Van der waals between molecules

3. a) i) Concentrated sulphuric (VI) acid.
ii) Potassium nitrate
iii) To condense the fumes of nitric (V) acid into liquid.

b) i) Nitric (V) acid will corrode/ react/ attack the rubber.

ii) The reaction produces nitrogen (II) oxide which is oxidized to nitrogen (IV) oxide. // Brown gas formed which is nitrogen (IV) oxide – because nitrogen (II) oxide is oxidized to nitrogen (IV) oxide.// Nitric (V) acid is being reduced to nitrogen (IV) oxide.

c) i) Water/ steam
- Cracking of alkanes/ crude oil
- Natural gas
- Passing steam over red hot coal
- Mercury cathode / fossil/ coal/ brine.

ii) $NH_{3(g)} + HNO_{3(aq)} \rightarrow NH_4NO_{3(aq)}$ Mass of ammonia in kg

Number of moles. $= \underline{6 \times 17 \times 10^4}$

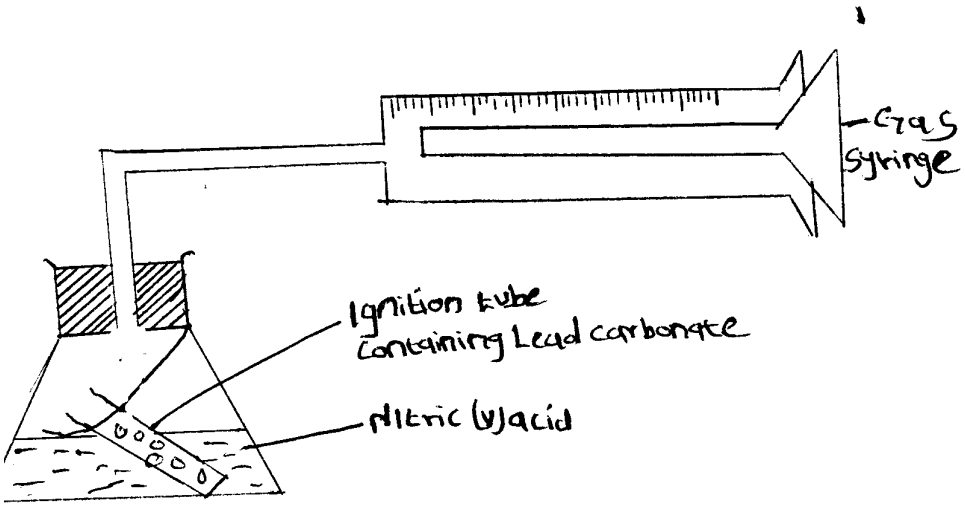
Of $NH_4NO_3 = \frac{4800}{80} \times 10 = 6 \times 10$ 1000

Number of moles $NH_3 = 6 \times 10^4$ = 1020kg

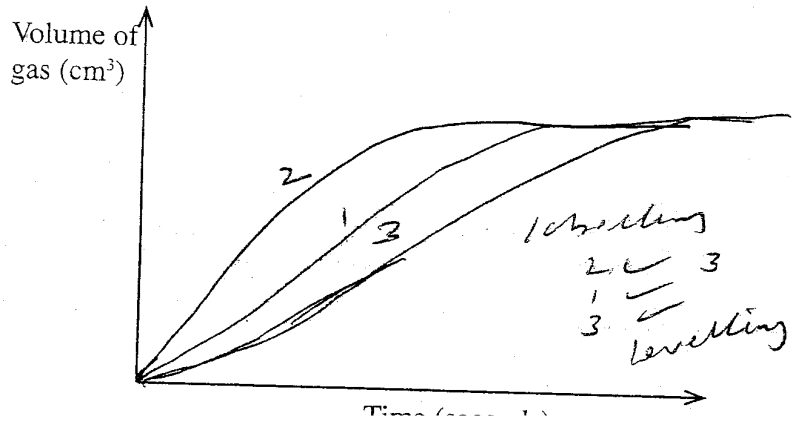
iii) Explosive – trinitroglycerine T.N.T
- Production of polymers
- Textiles and drugs

- Drugs
- Nitric (V) acid is used as an oxidizing agent
- Royal water – aquatic used in the extraction of gold.
- Used in etching of glass water

4. a)i) Surface area / particle size.



ii)



iii) $PbCO_{3(s)} + 2HNO_{3(aq)} \rightarrow Pb(NO_3)_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

c) With hydrochloric acid an insoluble lead (II) chloride is formed which coats the remaining lead (I) carbonate.

d) The intensity of yellow orange colour increases
- Equilibrium shifts to the left// backward rxn is favoured// rate of backward rxn is greater than that of forward rxn.

5. a)i) The anode is X.
Since hydrogen is liberated at the cathode which is Y.

ii) $4OH^-_{(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)} + 4e^-$

iii) Water is dictrolysed or decomposed.
Hydrogen ions and hydroxide ions are discharged.
Amount of water electrolysed is more than the amount of water formed at the anode.

iv) Blue litmus remains blue while red litmus remains red.

b) Number of coulombs = 0.3 x 30 x 0
= 540c.

Coulombs converted to faraday = $\frac{540}{96500}$

Faraday converted to moles $\frac{540}{96500} \times \frac{1}{4}$

Moles to volume $= \frac{540}{96500} \times \frac{1}{4} \times 24$
$= 0.0335dm$
2d.p

c) -Electroplating
- Purification of metals
- Extraction of reactive metals – K, Na, Al, Mg + Zn.
- Manufacture of chlorine gas
- Manufacture of hydrogen gas
- Manufacture of sodium hydroxide.

6. a) i) O_2^-

ii) $CuCO_3$, $ZnSO_4$

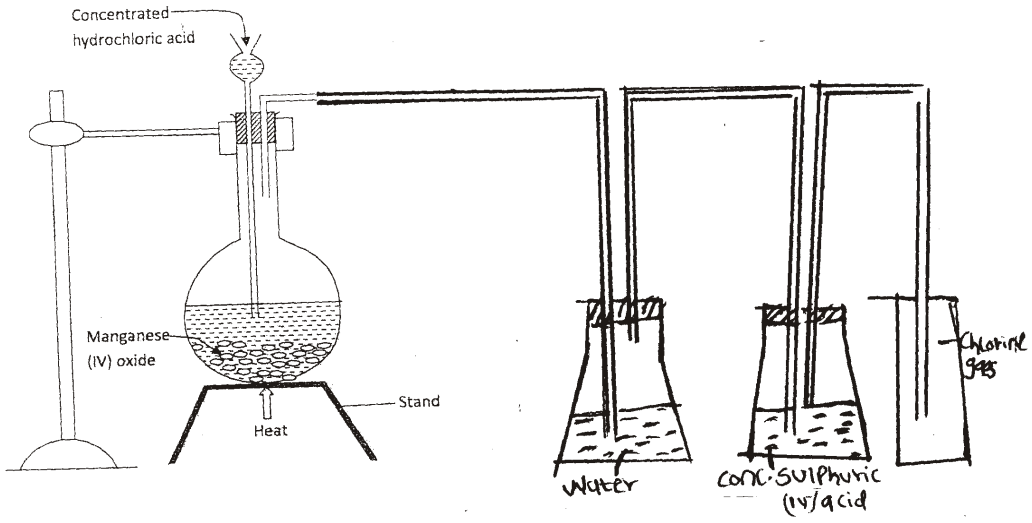
b) $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

c) The solution changes from blue to colourless/ fade
A brown solid is formed./ magnesium dissolves
Discharged of Cu^{2+} copper (V) ions/ because magnesium displaces copper (II) ions from the solution.
Apparatus becomes warm – reactions is exothermic – heat is given out.

d) i) Add nitric(V) acid to lead oxide add a soluble sulphate// sulphuric (VI) acid to the filtrate. Filtrate acid then dry the residue between filter papers.

ii) Determine the melting point, if it is pure the melting point will be sharp/ or constant.

7. a) i)



ii) Potassium manganate (VII) and remove heat.
PbO and heat.
Ca OCl_2 and no heat

iii) I. $2Fe^-_{(s)} + 3Cl_{2(g)} \rightarrow 2FeCl_{3(s)}$

II. $6NaOH_{(aq)} + 3Cl_{2(g)} \rightarrow 5NaCl_{(aq)} + NaClO_{(s)} + H_2O_{(l)}$

b) Cl O $\underline{0.02}$ $\underline{0.07}$

0.71	1.12	0.02		0.02
35.5	16	1	:	3.5
0.71	1.12	2	:	7
35.5	16	Empirical formula Cl_2O_7		

c) - Manufacture of chloroform
- Manufacture of potassium
- Chlorate/ sodium chlorate
- Manufacture of bleaching agent
-Manufacture of tetrachloromethane
- Bleaching of wood pulp.
- Manufacture of polychloroethene (P.V.C)
- Manufacture of calcium chlorate ($CaOCl_2$)
- Manufacture of plastics

CHEMISTRY PAPER 233/2

K.C.S.E 2013 MARKING SCHEME

1. (a) (i) **r** - (1) it has the largest atomic radius with the weakest nuclear attraction for outermost electron (1).

(ii) Across the period the atomic radius decreases due to the increase in nuclear attraction (1). Number of electrons in **P** is greater than in **H**.

(iii)

(iii) $2M(s) + 2H_2O(\ell) \longrightarrow 2MOH(aq) + H_2(g)$ (1)

Moles of $H_2 = \frac{200}{24000} = 0.0083$ $(\frac{1}{2})$

Moles of $M = 0.0083 \times 2 = 0.0166$ $(\frac{1}{2})$

$\frac{\text{Moles of M}}{\text{RAM}} = 0.0166$

Mass of $M = 0.0166 \times 7$ $(\frac{1}{2})$

Mass of $M = 0.117$ g $(\frac{1}{2})$

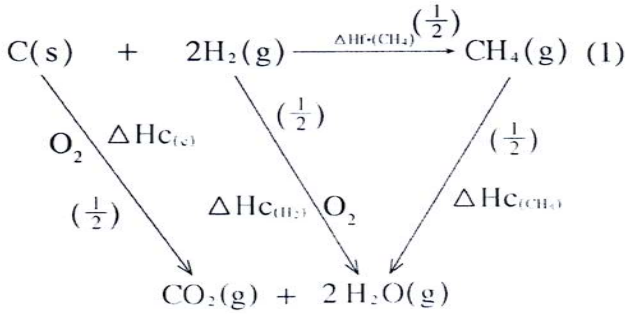
(b) (i) **W** - (1) forms a basic oxide which forms an ionic bond (1).

(ii) **Y** - (1) the oxide is gaseous that forms a neutral solution (1).

(iii) **U** - (1) the oxide is solid at room temperature, which is acidic with covalent bond (1).

2. (a) (i) This is the heat absorbed or evolved when one mole of any substance is formed from its constituent elements in their normal states. (1 mark)

(ii) I



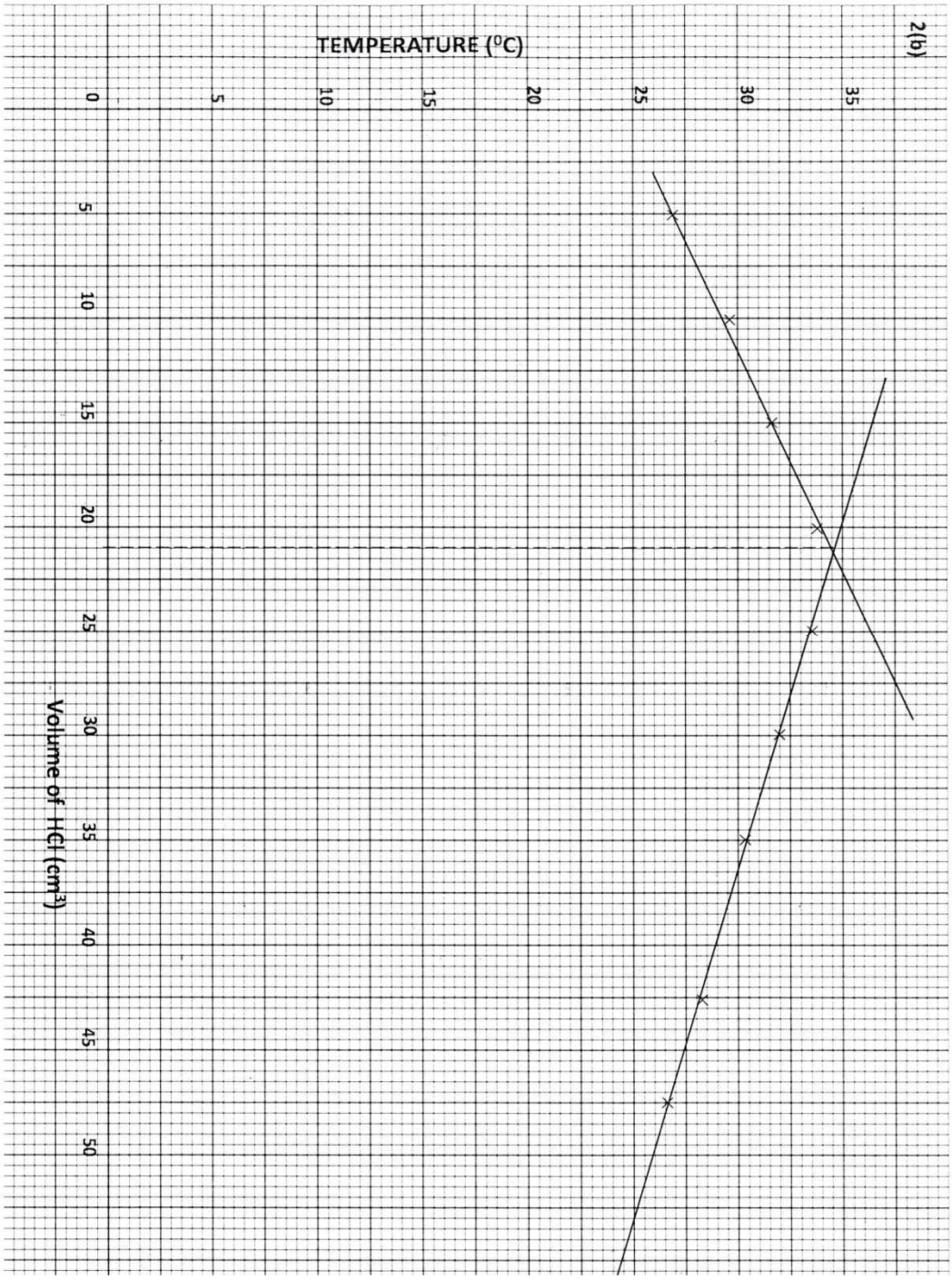
II $\Delta Hf(CH_4) = \Delta Hc(c) + 2\Delta Hc(H_2) - \Delta Hc(CH_4)$

$= -393 + 2(-286) + 890$ (1)

$= -965 + 890$

$= -75\ kJ\ mol^{-1}$ (1)

(b) (i)



(ii) I 34.80C (½)
II 21.2 cm^3 HCL (½)

(iii) 50 x 9.8 x 4.2 (1)
= 2058 Joules (1)

(c) The molar heat of neutralisation between a strong acid and a weak base is low because some of the heat is used to ionise (1) the weak base before neutralization. For strong acid and strong base they are completely ionised.

3. (a) (i) Hot compressed air (1)

(ii) To melt the sulphur and maintain it in molten state (1)

(iii) - low melting point of sulphur (1)
- insolubility of sulphur in water (1)
- less dense than water

(b) (i) $s(s) + O_2(g) \longrightarrow SO_2(g)$

(ii) To dry the SO_2 and air (1)

(iii) Vanadium (v) oxide (1) and platinum (1) or titanium

(iv) - it provides the reactants (SO_2 and O) with enough energy to react (1)
- it removes heat from the product hence preventing decomposition (1)
or conserves heat, or recycles heat or reduces cost of production.

Accept any other.

(c) - contributes to acid rain which corrodes buildings (1)
OR
- causes aquatic solutions to be acidic hence affecting aquatic life etc.
- poisonous/toxic

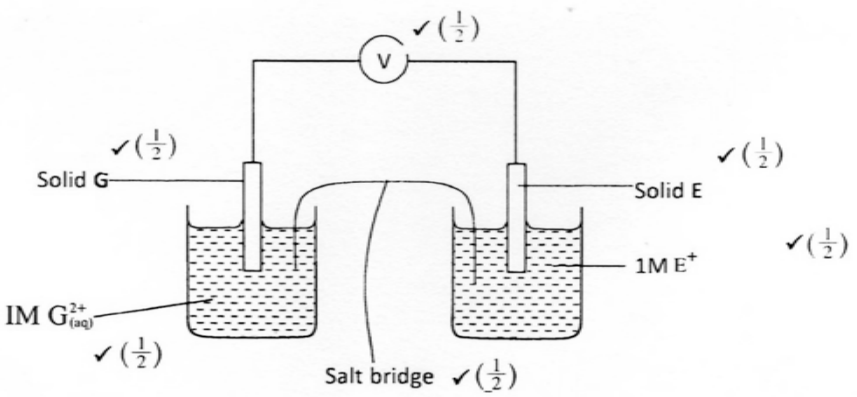
(d) Turns black (½) removes hydrogen and oxygen from the sugar molecule leaving only carbon which is black (½) . Dehydration of sugar forms carbon which is black.

4. (a) (i) Gas Y is chlorine. (1)

(ii)
- sodium and hydrogen ions migrate to the cathode (½) . The hydrogen ions are preferentially discharged, liberating hydrogen gas.
- chlorine and hydroxide ions migrate to the anode (½). The chloride ions are preferentially discharged liberating chlorine gas.
- the sodium ions combine with the hydroxide ions to form sodium
- the sodium ions migrate to the cathode through the membrane (½) hydroxide .

(iii) Glass making/paper manufacture (1), unclogging of drains, etching $NaClo_3$
Purification of bauxite.

(b) (i)



(ii) EMF = 0.8 + 2.87 (1)

= 3.67V (1)

(iii) H will go into solution as H^{2+} ions (1) since it is more reactive than E hence displacing E^{+} ions which are deposited as solid (1).

5. (a) Test the acidity using a litmus pager. There will be no change on litmus when dipped into a solution of sodium sulphate (1). The litmus paper turns to red when dipped into a solution of sodium hydrogen sulphate (I).

OR

Add a solid carbonate to each solution. No effervescence observed when the carbonate is added to a solution of sodium sulphate. Effervescence is observed when the carbonate is added to a solution of sodium hydrogen sulphate.

(b) Add dilute nitric acid (½) to lead to form a soluble salt, $Pb(NO_3)_2$, add a soluble salt sodium sulphate to form insoluble (½) and soluble Na_2SO_4 (½) separate by filtrating (½) . Wash the $PbSO_4$ (½) with distilled water to remove traces of (½) soluble salt, Na_2SO_4. Then dry the salt between filter papers (½)

(i) I $NH_4NO_3(s) \longrightarrow N_2O(g) + 2H_2O(g)$ (1)

II $2Fe(OH)_3(s) \longrightarrow Fe_2O_3(s) + 3H_2O(l)$ (1)

(ii) The colour changes from pale green to brown (1). The iron (II) is oxidised to iron (III) chloride by hydrogen peroxide (1)

(iii) Carbon monoxide (1)

6. (a) A proton has a +ve charge while a neutron has no charge (1)

(b) Substances undergo radioactive decay or disintergration. (1)

(c) - causes genetic mutation (1)

- can cause death (1)
- prone to cancer

(d) (i) I Atomic mass of a = 4 (1)
II Atomic number of b = 2 (1)
(ii) Fusion (1)

(e) (i) This is the time taken for half of the radioactive isotope to decay (1)
(ii) 288- 144 -72- 36 -18 -9
∴ 5 half lives (1)
$^{40}/_{5}$ = 8days (1)

7. (a) (i) Propanoic acid (1)
(ii) Pent - 1 - ene (1)
(iii) But - 1 - yne (1)

(b) (i) Ethane (1)
(ii) C
(iii) I Water/steam/Conc. H_2SO_4
II Acidified potassium dichromate (VI)

(iv) $2CH_2CH_2CH_2OH + 2Na \longrightarrow 2CH_3CH_2CH_2ONa + H_2$

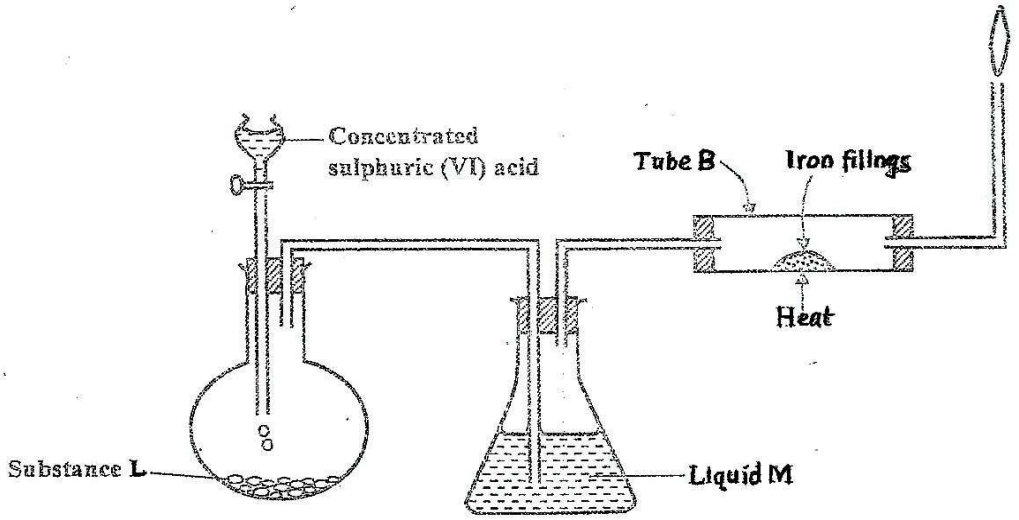
(c) Cleansing agent has the hydrophilic (½) and hydrophobic ends (½), the hydrophobic end is attracted to grease (½) while the hydrophilic end is attracted to water (½) during agitation the grease is pulled off (½) the cloth then surrounded by soap molecules (½)

CHEMISTRY PAPER 2

MARKING SCHEME

THEORY

1a)The set up below was used to prepare dry hydrogen chloride gas, and investigate its effect on heated iron filings.



i). Name substance L 1 mk

Rock salt / sodium chloride / potassium chloride

ii) Name liquid m 1 mk

Concentrated sulphuric (VI) acid penalize *½ if concentrated is missing, accept formula*

iii) What will be observed in tube B? 1 mk

Grey solid turns to green ½

iv) Write an equation for the reaction that occurs in tube B. 1 mk

$$Fe_{(s)} + 2HCl_{(2)} \longrightarrow Fecl_{2(s)} + H_{2(g)}$$

Penalize ½ for missing or wrong state symbols penalise fully if not balanced

v) Why is the gas from tube B burnt? 1mk

To prevent an explosion in the gas mixed with air

bi)Explain the following observations

i. A white precipitate is formed when hydrogen chloride gas is passed through aqueous silver nitrate 1 mk

Reaction produces insoluble silver chloride ½

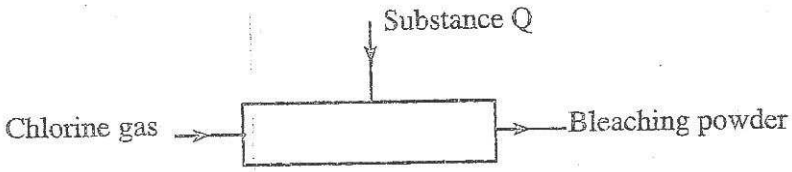
ii. Hydrogen chloride gas fumes in ammonia gas 1 mk

The fumes are due to ammonium chloride which is white ½

ii) State two uses of hydrogen chloride gas 1 mk

- **Manufacture of PVC ½**
- **Manufacture of ammonium chloride**
- **To make hydrochloric acid**

c) The diagram below is a representation of an industrial process for the manufacture of a bleaching powder



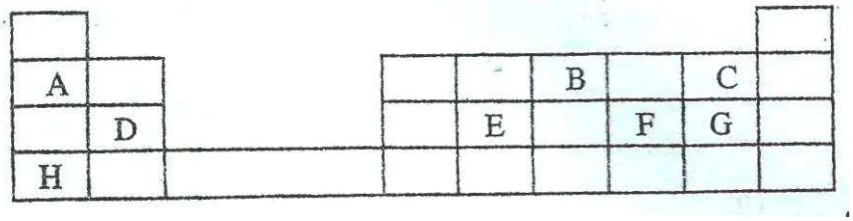
i) Name substance Q

Calcium hydroxide $Ca(OH)_2$

ii)When the bleaching powder is added to water during washing, a lot of soap is used. Explain 1 mk

Due to presence of calcium ions (Ca^{2+}) which make the water hard

2a) The grid below represents part of the periodic table . Study it and answer the questions that follow. The letters are not the actual symbols of the elements



i) Select the most reactive metal. Explain (2mks)

H/ It has largest atomic radius / its outcome electron is loosely held / it has highest tendency to loose electron

ii) Select an element that can form an ion with a charge of 3^- (1 mk)

B/Nitrogen accept actual element

iii) Select an alkaline earth metal (1mk)

D

iv) Which group 1 element has the highest first ionization energy?
Explain (2mks)

A- It has the smallest / smaller atomic radius therefore its outermost electron is more strongly held by nucleus

v) Element A combines with chlorine to form a chloride of A. State the most likely pH value of a solution of a chloride of A. Explain 2mks

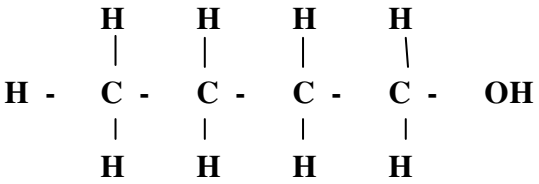
Ph = 7
Neutral therefore the pH is likely to be 7. It is neutral salt form a neutral solution

b)i)Explain why molten calcium chloride and magnesium chloride conduct electricity while carbon tetrachloride and silicon tetrachloride do not. (2mks)
Molten $CaCl_2$ or $Mgcl_2$ have free and mobile ions while $CC1_4$ and $SiCl_4$ exist as molecules with no free ions

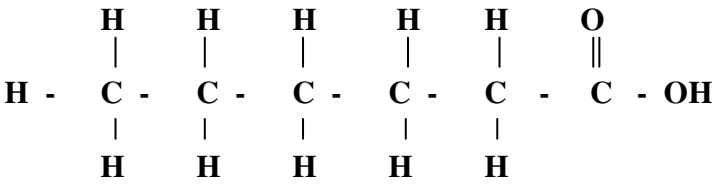
ii) Under the same conditions , gaseous neon was found to diffuse faster than gaseous fluorine. Explain this observation. (F=19.: Ne=20.0) (2mks)
Neon is mono atomic gas with M.M of 20 while fluorine is diatomic with molar mass of 38. The lower the m.m the faster the rate of diffusion

3. a) Draw the structures of the following

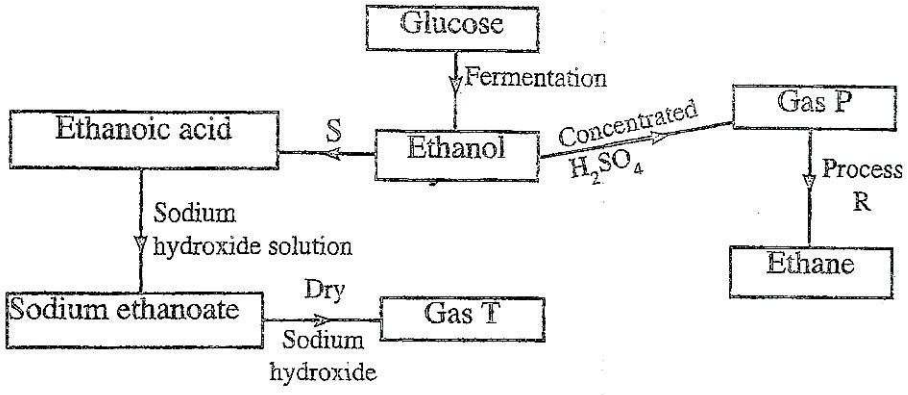
i)Butan -1-*0l* 1mk



ii)Hexanoic acid. 1mk



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



i) State the conditions necessary for fermentation of glucose to take place 1mk
Yeast / enzyme, temperature $35^0c – 40^0c$

ii)State one reagent that can be used to carry out process S. 1 mk
Acidified $KMn0_4$/ Acidified $K_2Cr_20_7$

iii) Identify gases 2 mks

P: Ethene

T:Methane

iv) How is sodium hydroxide kept dry during the reaction 1mk

By mixing it with Ca $(OH)_2$ or CaO

v) Give one commercial use of process r

Manufacture of margarine / hardening of oils

c) When one mole of ethanol is completely burnt in air, 1370kJ of heat energy is released. Given that 1 lire of ethanol is 780 g , calculate the amount of heat energy released when 1 litre of ethanol is completely burnt (C = 12.0; H=.0; 0=16.0)

C_2HSOH = 46 **1 Mole produce 1370 k**

Moles burnt = $^{780}/_{46}$ **16.9565 mole produce = 23230**

=16.9565 Moles

d) State two uses of ethanol other than as an alcoholic drink 2mks

Used as a solvent **- Antiseptic**

Used in thermometers **-Manufacture of synthetic flores**

Used as a fuel

4. a)Other than temperature, state two factors that determine the rate of a chemical reaction 1mk

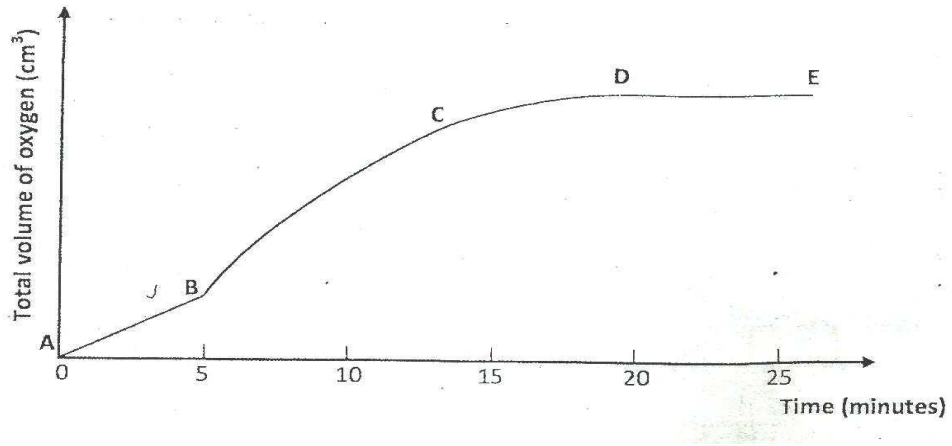
Concentration of reactants

Surface area of reactants

Catalyst

Pressure

(b) A solution of hydrogen peroxide was allowed to decompose and the oxygen gas given off collected. After 5 minute, substance G was added to the solution of hydrogen peroxide. The total volume of oxygen evolved was plotted against time as shown in the graph below



(i)Describe the procedure of determining the rate of the reaction at minute 12. 13marks

- **Draw a tangent at 12th min**
- **Determine gradient of tangent**
- **Calculate gradient =** $\frac{vol}{time}$

ii)How does the production of oxygen in region AB compare with that in region BC? Explain 2mks

The rate of production ofO_2 in BC is higher than in AB. in BC reaction is catalysed

iii)Write an equation to show the decomposition of hydrogen peroxide . 1mk

$2H_2O_2(1) \longrightarrow 2H_2O_{(2)} + O2_{(g)}$

Must be balanced

c) Sulphur (IV) oxide react with oxygen to form Suplhur (VI) oxide as shown in the equation below

$2SO_{2(g)} + O_{2(g)} \leftrightarrows 2SO_{3\,(g)}$: $\Delta H = -192kJ$:

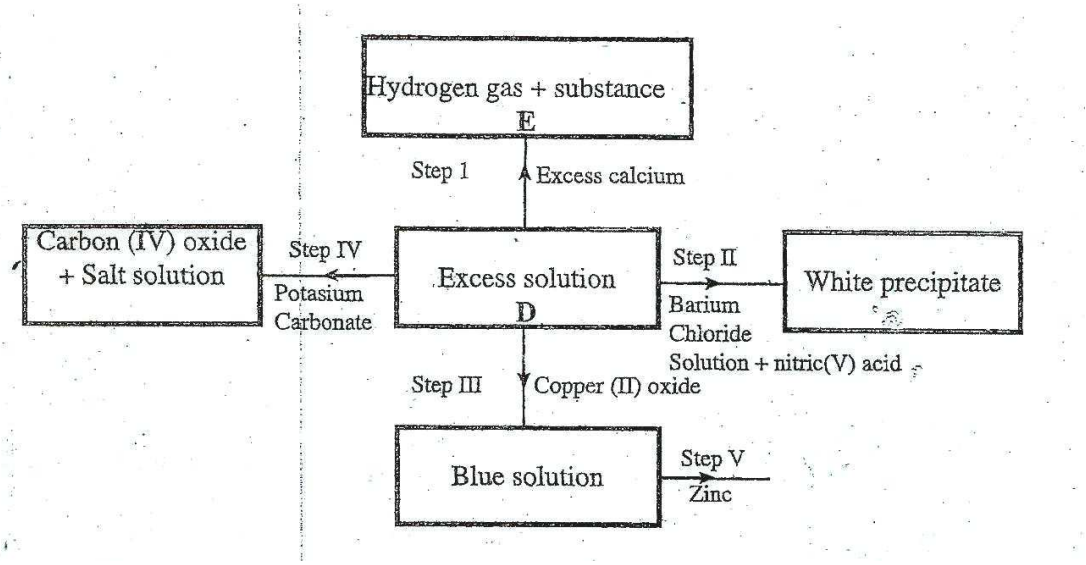
i)Explain the effect on the yield of SO_3 of lowering the temperature of this reaction 2mks

The yield of SO_3 increases since the forward reaction is exothermic, hence forward reaction is favoured

ii)Name one catalyst used for the reaction 1mk

Vanadium (v) oxide or platinum

5a) The scheme below shows some of the reaction of solution D. Study it and answr the questions that follow



i)Give a possible caution present in solution D 1 MK

H+

ii)Write an ionic equation for the reaction in Step II 1 mk

$Ba^{2+}_{aq} + SO_4{}^{2-}_{aq}$ $BaSO_{4(s)}$

iii)What observations would be made in Step V? Give a reason 1 mks

- **Blue colour of solution fades away**
- **Brown deposit / solid**
- **Zinc displaces Cu^{2+} ions form solution since zinc is more reactive than copper**

The brown solid is copper

Or t-t becomes warm since reaction is exothermic

iv)Explain why the total volume of hydrogen gas produced in step 1 was found to be very low although calcium and solution D were in excess. 2mks

Calcium reacts with dil H_2SO_4 to form $CaSO_4$ which is insoluble , it coats the Ca preventing further reaction.

v)State one use of substance E. 1 mk

Manufacture of plaster of paris

Making white wash

b)Starting with solid sodium chloride, describe how a pure sample of lead (II) Chloride can be prepared in the laboratory 3mks

Add water to Nacl to form solution

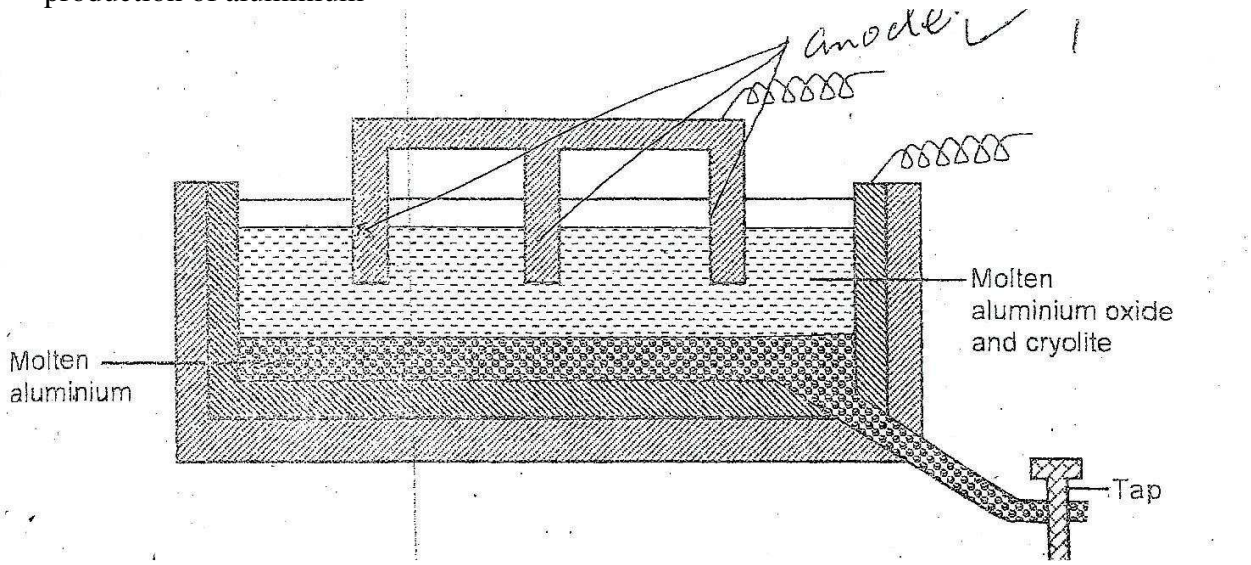
Add aqueous $Pb(NO_3)_2$ to the aqueous Nacl to precipitate out the $Pbcl_2$, filter and wash the residue with distilled water then dry it between filter papers

c)i)State a property of anhydrous calcium chloride which makes it suitable for use as a drying agent for chlorine gas. 1 mk

It is hygroscopic / deliquescent / absorbs moisture
It does not react with C/2

ii) Name another substance that can be used to dry chlorine gas 1 mk
Concentrated sulphuric (VI) acid

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



a) One the diagram, label the anode 1mk
b) Write the equation for the reaction at the anode 1mk
$2O^{2-}(i) \longrightarrow O_{2\,(g)} + 4e^-$

c) Give a reason why the electrolytic process is not carried out below 950^0C 1mk
Below 950^0C the electrolyte is not in molten state since M.P Of Al_2O_3 is higher than 950^0C

d) Give a reason why the production of aluminium is not carried out using reduction process 1mk
Al is more reactive than carbon

e) Give two reasons why only the aluminium ions are discharged 2mks
Aluminium is less reactive than sodium
Al^{3+} ions are in higher concentration than Na^+

f) State two properties of duralumin that makes it suitable for use in aircraft industry
Light or low density
Strong **2mks**

g)Name two environmental effects caused by extraction of aluminium 2mks
- **Global warming due to production of CO_2**
- **Formation of gullies resulting to soil erosion**

7a) Dissolving of potassium nitrate in water is an endothermic process. Explain the effect

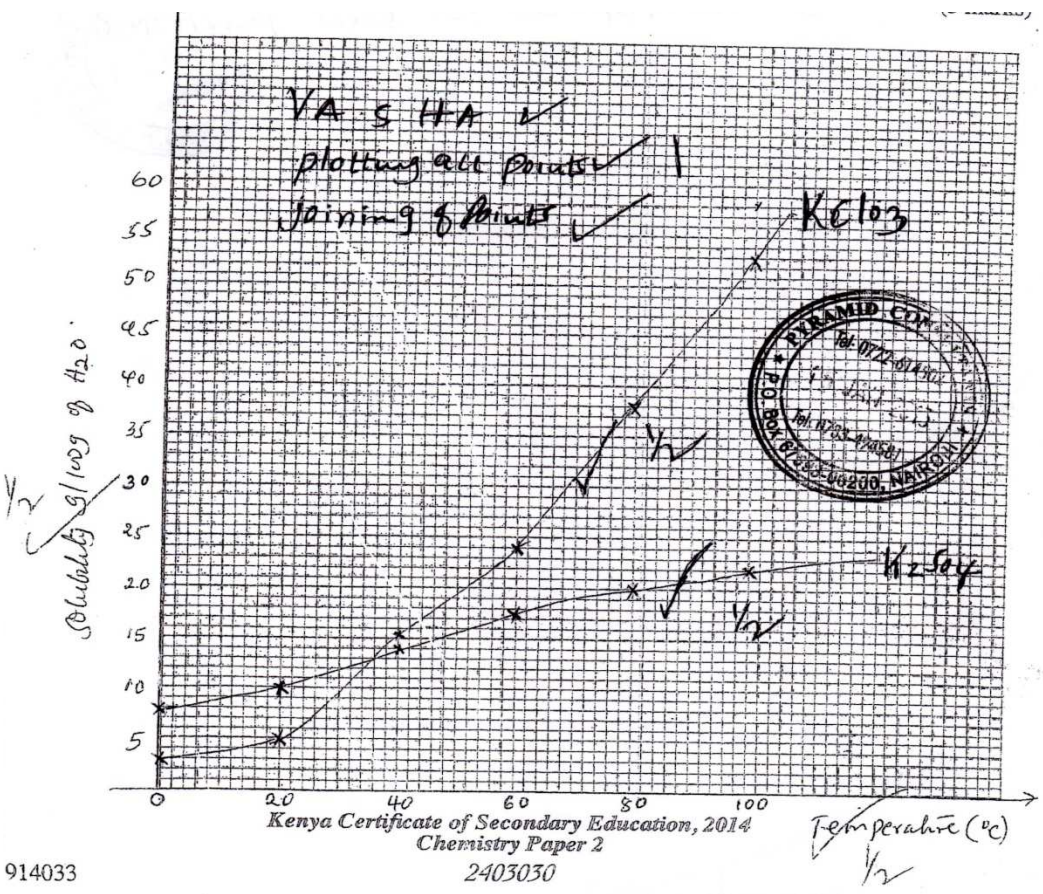
of increase in temperature on the solubility of potassium nitrate 2mks

Solubility of KNO_3 will increase since as temperature is increased the process which absorbs heat is favoured. The solvent molecules move further apart creating more space for social parties.

b) The table below shows the solubilities of potassium sulphate and potassium chlorate (V) at different temperatures.

Temperature (^0C)	0	20	40	60	80	100
Solubility of K_2S0_4 G/100 g water	8.0	10.0	14.0	17.5	20.0	22.0
Solubility of $KC10_3$ g/100g water	3.0	5.0	15.5	24.0	38.0	53.0

a) Draw the solubility curves for both salts on the same axis. (Temperature on the X-axis 3mks)



ii)A solution of potassium sulphate contains 20g of the salt dissolved in 100 g of water at 100^0C. This solution is allowed to cool to 25^0C

I)at what temperature will crystals first appears?

80^0C –read form the graph temperature of 20g

II)What mass of crystals will be present at 25^0C? 1mk

20-Solubility at 25^0C ½

iii)Which of the two salts is more soluble at 30^0C? 1mk

K_2SO_4

iv) Determine the concentration of potassium sulphate in moles per litre when the solubility of the two salts are the same (K= 39.0, O=16.0 ; S=32.0) 3mks

Read from graph **morality =** $\frac{g/litre}{RFM}$

13 x 1000 **=** $\frac{130}{174}$

100

=130g / litres **= 0.747M**

v) 100 g of water at 100^0C contains 19g of potassium sulphate and 19 g of potassium chlorate (V). Describe how a solid sample of potassium sulphate at 60^0C can be obtained (2mks)

- **Filter crystals of K_2SO_4 / decant**
- **Dry between Filter papers**
- **At 60^0c only 17.5 g of K_2SO_4 would have dissolved while the whole of $KClO_3$ would have dissolved**
- **filter the 50 m to obtain the remaining 19-17.5 g of K_2SO_4 . dry the 1.5 g of K_2SO_4 btn filter papers**