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1. a) x-2, 8, 3 , ∨ (1mks) Y- 2, 8 6 ∨ (1mks)
   b) X_2Y_3 ∨ OR Al_2S_3 (1mk)
2. The mixture would turn brown due to excess $Br_{2\,(g)}$ / H+ ions removes OH- ions from the mixture / equilibrium shifts to the left/observation not there BUT equilibrium shift to the left/ more Br□ formed for observation (2mks)

3. 1 mole CaCO3 2 moles of HCL
   Therefore 0.1($^1/_2$) mole CaO3 0.2 Mole (½) CaCO3
   = 40 + 12 + 48 = 100g (½)
   Therefore 15g Ca CO3 = 15 = 0.15Moles
   100g
   Excess moles 0.15 – 0.05 (½)
   Excess mass= (0.05) x 100 (½) = 5g (3mks)

4. a) II because it requires little soap to lather (2mks)
   b) III has temporary (½) hardness, which is removed by boiling (½) (1mk)
5 a) sisal/ Cotton/ wool/ silk /jule/hemp/fur/hair (1mk)
   b) They are stronger than natural fibres/OR are not easily affected by chemicals/lasts longer /durable/ can be produced easily in a large scale therefore cheaper (Reject. Strong bonds) (1mk)
6. a) Pass the mixture through H2SO4 which absorbs D then collect by downward delivery/pass the mixture though NaoH(aq) which absorb D and then collect by downward delivery (upward displacement) (2mks)
   b) Ammonia (½) – Gas- D reacts with the acid (½) / basic/ is less denser / lighter than air. (1 mk)
7 II Because pure substances have sharp MP and BP as shown by the flat regions of curve II. (accept systematic) (2mks)
8. a) $2H_2sO_4$
   b) Insoluble in water/slightly soluble in water (1 mk)
   To ensure that the air that occupied the apparatus initially is expected (reject impurities) (1 mk)
9. When circuit is completed bulb lights (½) brown substance (½) formed grey (½)substance formed on cathode; because PbBr2 acts as an electrolyte (½) /free /mobile (½) ions; lead ions gain electrons to form pb(½) (Lead) and loses electrons to form (½) Bromine (Br)
   (Equations show ions current flow) (3mks)
10. a) To remove oxide coating which could inhibit reaction (1 mk)

b) ORP

11. a) addition (1mk)

b) $CH_3CH = CH_2(g) + Cl_2(g) \longrightarrow$ CH3 CHCICH2 CL (g)

OR

$C_3H_6 + Cl_2$ (1 mk)

12. Hydrogen forms compounds by losing one electron like group I elements or by gaining one electron like group VII element /Hydrogen has one electron in outermost shell. (2mks)

Al(s) + 6H+ (aq) 2A13+ (aq) + 3 (g)

A1(s) +6OH-(aq) A1 (OH) (aq) + 2H O (g)

13. a) Wood ash is basic/ alkaline and would therefore react with aluminium Utensils/amphoteric/ 2A(s) + 6H + (aq) 2A13 + (aq)) + 3 H_2 (g) (2mks)

b) It is strong ($^1/_2$) and not easily corroded ($^1/_{2)}$ / Does not rust (1mk)

14. a) (C3H6O)n = 116

(3 x 12 + 6 + 16)n =116 ($^1/_2$) Molecular formulae = 2(C H O)

58n = 116 ($_1/_2$) = $C_3H_{12}O_{2(1/2)}$

N = 116 = 2($^1/_2$) (2mks)

58

b)Percentage of Carbon = $\frac{12x6x}{116}$ 1000($^1/_2$) = 62.07 ($^1/_2$) Range (62.05 – 62)

OR

$\frac{3 \times 12}{58} \times 100\ (1/2) = 62.07\ (1/2)$ (mark consequently)

15. Cool the mixture to a temperature below – 196°C to form a liquid then start warming, Nitrogen distils off a gas at – 196O (cool first) (2mks)

16.a)

Alkaline	Formula	Heat of combustion (Hc)kjmol^{-1}
Methane	CH_4	- 890
Ethane	C_2H	- 1560
Propane	C_3H_8	- 2220
Butane	C_4H_{10}	- 2870 – 2880($^1/_{2)}$

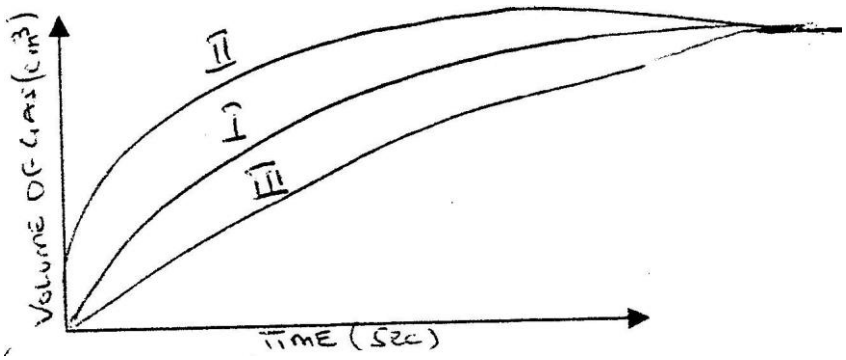
(Correct answer only –ve sign)

(award full mark if figure is not ±)

2220 - 1560 = 660

1560 – 890 = 670

2220 + 650 = 2870



21. W because its solubility decreases with increase in temperature
(Accept any value 2870)Any calculation (1mk)

b) Hc is an exothermic reaction. (1mk)

17. a) I – Molten sulphur

b) II – Superheated water / water.

18. a) 2HCl (aq) + Zncl (aq) + H2 (g) ($^{-1}/_{2}$) states)

b) $2H_2$ (g) + O_2 (g $\longrightarrow$ $2H_2O$ (g) (Not L) ($^{-1}/_{2}$ state)

19. Hydrogen, because it is lighter/ less denser / diffuses faster (2mks)

20.

22. a) i) NO-3 : O3- = -6

. . N = + 5 (+5) (don't mark formula) (1mk)

ii) NO

O = 02 . . N = + 2 (1mk)

b) Reduction ($^{1}/_{2}$) because the nitrogen ion in NO gains 3 electrons ($^{1}/_{2}$) to form the nitrogen in NO. (1mks)

23. The chloride form ions in water which conduct electric current. NO ions are formed in methylbenzene /chloride exists in methylbenzene as molecules. (2mks)

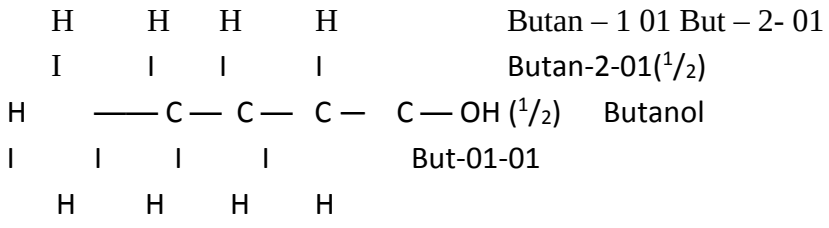
24. A gas with a smell of rotten eggs is formed H_2S gas is formed / A greenish solution is formed? Effervescence / A gas is produced / Black solid dissolves. (1mk)

25. Dissolve the potassium sulphate ($^{1}/_{2}$) in water, dissolve ($^{1}/_{2}$) the lead carbonate in the nitric acid, mix the two solutions ($^{1}/_{2}$) and filter ($^{1}/_{2}$) off the lead sulphate precipitate// Dissolve lead carbonate in nitric acid add solid $pbSO_4$ and filter off (max^{1} ½)// Dissolve this in HNO_3 and add solid $pbCO_3$ and filter off the precipitate.

26. Enthalpy of neutralization between CH_3 CaOH $_{(aq)}$ and NaOH $_{(aq)}$ is lower than that between HCl $_{(aq)}$ and NaOH because CH_3 CaOH $_{(aq)}$ is a weak acid which does not

dissociate fully in water thus some of heat produced is used for dissociation fully dissociated and partially dissociated. (2mks)

27. Ca (OH) 2 (aq) forms white precipitate (1/2) with CO2 Can be observed NaOH(1/2)(aq) does not form a precipitate. (1mk) 28. a) Structural formula



b) $2CH_3CH_2CH_2OH_{(l)} + 2K_{(S)} \longrightarrow 2CH_3CH_2CH_2CH_2OK^+(l) + H_2(g)$

$2S_9H9OH + 2K \longrightarrow 2C_4H_9OK + H_2$ (1mk)

29. **a)** Yield would increase ($1/_2$) since H us position/ thus increase in temperature shift the equilibrium to the right .Since H is positive ($^1/_2$) (1mk)

No effect (1/2) volume on the left (1/2) is the same as on the right//moles on left same as moles on the right.(1mk)

30. a) 100g of Pa $\longrightarrow$ 50g if Pa $\longrightarrow$ 25g Pa $\longrightarrow$ 12.5 (g)

. . 3t ½ = 81(1/2) t=1/2 = 27 days (1/2) (2mks)

b) Mass number – 233 (1/2)

Atomic number – 92(1/2) (1mk)

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1. a) K and N because they are in the same group OR loses 2 electrons/same number or electrons sins the outer energy level (2mk) b) L $_2O_2$ OR L_2O (1mk)

c) L, because it has 7 electrons in its outermost energy level (2mk)

d) M, Because its ionic radius is bigger than atomic radius so its tendency to donate its electrons is high

(e) M and N arc in the same period. Across the period ionic radius decrease due to increase in nuclear charge OR nuclear charge of N is greater than M. L gains electrons to form L. There's increase in repulsion of electrons (2mks)

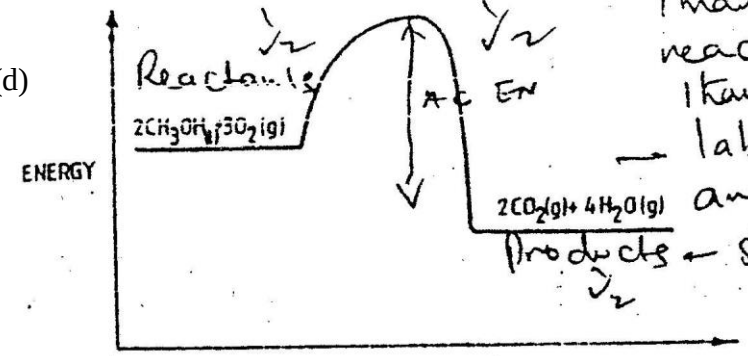
2. (a) (i) Liquid P – concentrated sulphuric acid (1 mk)

Solid Q- Aluminium (III) chloride OR $AICI_3$ (1 mk)

(ii) Anhydrous calcium chloride or fused calcium or lumps of calcium chloride (1 mk)

(iii) The blue litmus paper turns red because the HCI(g) that does not react with the aluminum dissolves in the water making it acidic. (2mks)

(d)



1 mark for the reactants is higher than the products
→ labelling the reacts and products ½ mark
← showing activation energy ½

4 (a) (i) Sulphur dioxide (1mk)

(ii) $2\ cuFeS_2(s) + 4O_2\ (g) \quad 2FeO(s) + Cu_2\ S(s) + 3SO_2(g)$ (1 mk)

(b) (i) $NH_4 + HCI\ (g) \quad NH_4\ CI(g)$ (1 mk)

(ii) $HCI\ (g) + NH_4\ (g) \quad NH_4CI\ (g)$ (½) Penalize ½ for wrong states)

Moles of HCL = $\frac{200}{24000}$ ½ = 0.00833 ½ moles HCI

0.00833 moles HCI = 0.00833 moles NH_4CI

$NH_4CI = 14 + 4 + 3.35 = 53.5g$ ½

(0.00833) (53.5) = 0.446 g (answers must be to 3dp)

$CH_3OH + 3O \quad CO_2$ + Heat (penalize ½ if wrong unit for answers)

(3 mks)

3. (a) $2CH_3OH(g) + 3O_2(g) \quad CO_2\ (g) + 4H_2O(g)$

(b) (i) 22.98 – 22.11 = 0.87 g methanol

R.F.M $CH_3\ OH$ = 12 + 3 + 17 = 32 (½)

0.87 (½) = 0.02718 (½) moles OR 0.02719 moles

Temp rise = 27 – 20 = 7 (½) (2 mks)

(ii) Heat change = H= 500 x 7 (½) x 4.2 = 14700j (½) if unit missing)

(2 mks)

(iii) 0.027 moles = 14700J

1 mole = $\frac{[14700]}{[0.027]} \times \frac{[1]}{[1000]} = 544.4\ kjmol^{-1}$

$\frac{[14700]}{[0.022718]} = 540.7\ kjmol^{-1}$

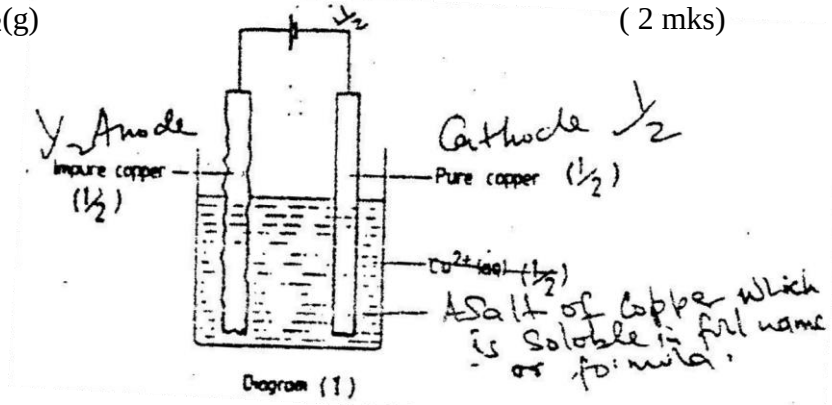
(c) This value is lower than the theoretical value because some of the heat is lost to the surrounding because apparatus is not shielded. Some more heat is also lost to the apparatus. Incomplete combustion of methanol (2 mks)

(iii) Fe^2 (1 mk)

(iv) P is carbon dioxide/carbon monoxide (1 mk)

(v) Reduction – oxidation (Redox) reaction because Cu_2O is reduced to Cu while coke to $CO_2(g)$ (2 mks)

(b)



(c) 1 mole of CuFeS = 1 mole Cu

210kg Cu = OR $\frac{210}{63.5} \times \frac{183.5}{810} \times 100$ or mass Cu in cores = $\frac{810 \times 63.6}{183.5}$ =

$$\%Cu = \frac{210}{280} \times 100 = 74.9\%$$

3.3 moles of Cu(s) = 3.3 moles CuFeS2

$CuFeS_2 = 63.5 + 56 + 64 = 183.5$ g

$= 183.5 \times 3.3 = 605.6 \times 10^3$g

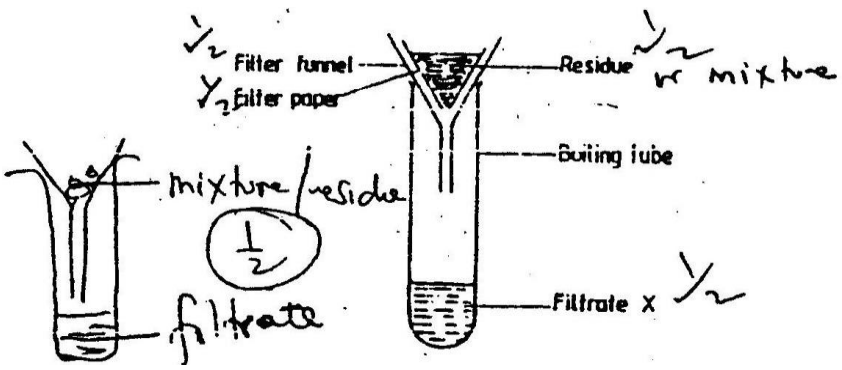
$$\text{Purity} = \frac{605.6 \times 1000 \times 100}{810 \times 1000} = 74.75\%$$

(d) Acid rain may from due to presence of SO_2 (g) and CO_2 (g) dumping of the waste like the slag prevent vegetation growth large gullies left after the ore is excavated destroys the environment (Do not accept presence of heat) (1 mk)

5. (a)

(iii) Zn^{2+} [Zn (aq) + $4NH^3$ (aq) $(NH_3)^4$

(iv) Brown coloured gas OR reddish brown (1 mk)



(v) Addition of anhydrous or $CuSo_4$ copper (II) sulphate which white

turns blue in presence of water or cobalt chloride paper which turns pink (1 mk)

(b) (i) One of the salts in R is not soluble in water because a residue is formed on addition of water (2 mks)

(ii) CO_3^{2-} because CO_2 (g) is produced on addition of acid (2 mks) (iii) Pb^{2-}(aq)

(c) Zinc nitrate (1 mk)

Lead carbonate (1mk)

6. (a) (i) Bitumen, it has highest B.P (2 mks)

(ii) Fractional distillation. During the distillation petrol would distil off at 175^0 and diesel could distil at 350^0C (2 mks)

(iii) Each component is mixture of hydrocarbons which have different boiling points

(iv) Methane CH_4(g)

Ethane C_2H_6

Propane C_3H_8

Butane C_4H_{10}

(b) Burning it in limited amount of air will produce carbon monoxide which is poisonous (2mks)

(c) Manufacture of tar used in tarmac/ sealing of roofs (1mk)

7 (a) (i) Liquid L is water

(ii) Black copper (II) oxide changes to reddish brown because it is reduced to copper by ammonia (1mk)

(iii) $2NH_3$ (g) + 3CuO(s) $3Cu(s) + N_2(g) + H_2O(I)$ (1 mk)

(iv) I 2 moles NH_3 1mole N2

$320cm^3NH_3$ $\frac{320}{2} = 160cm^3$

II Moles of $NH_3 = \frac{320}{24000} = 0.133$

2 moles of NH_3 = 3 moles CuO

Moles pf CuO – $\frac{320}{1} \times \frac{1}{2} \times \frac{3}{5} = 0.02$ moles

RFM OF CuO = 63.5 + 16 = 79.5

Mass of CuO= 0.02 x 79.5g = 1.59g (3mks)

(v) The excess ammonia from the reaction dissolves in the water in the beaker to form ammonium hydroxide which is a weak alkali or base of pH about 10. (2 mks)

(b) The burning splint would be extinguished (1 mk)

(c) Because it is cheaper and ammonia is made from nitrogen (1mk)

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1. Air is less dense than carbon dioxide and so it enters the polous pot faster than carbon dioxide out of it. This sets up a higher pressure; in the pot and the level rises as shown:

2. $P_1V_1 = P_2V_2$ OR $\frac{V1}{I_2} = \frac{V_2}{I_2}$ (Charles' Law)

$V_2 = \frac{P_1V_1T_1}{T_1P_2}$ $V2 = \frac{250x315}{300}$

$= \frac{750x250\ x315}{300x\ 750} = 262.5$

3. a) Moles of Zn = $\frac{196}{65.4}$ 0.03

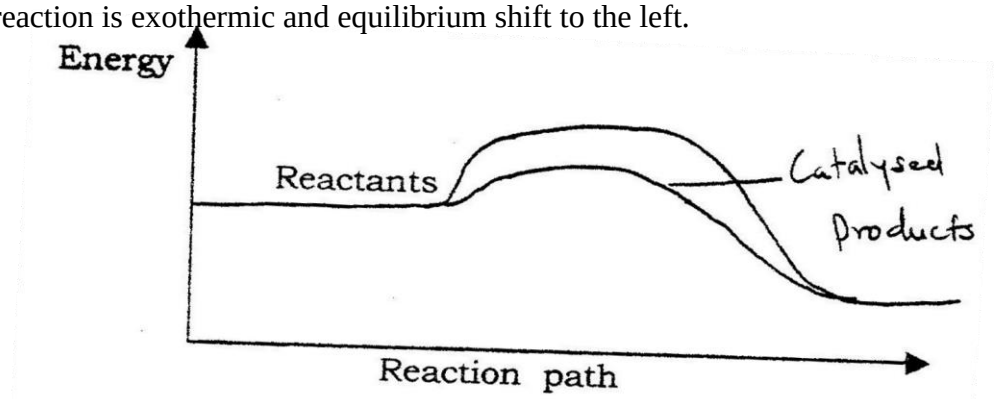
Holes of HCL = $\frac{100 \times 0.2}{1000} = 0.02$

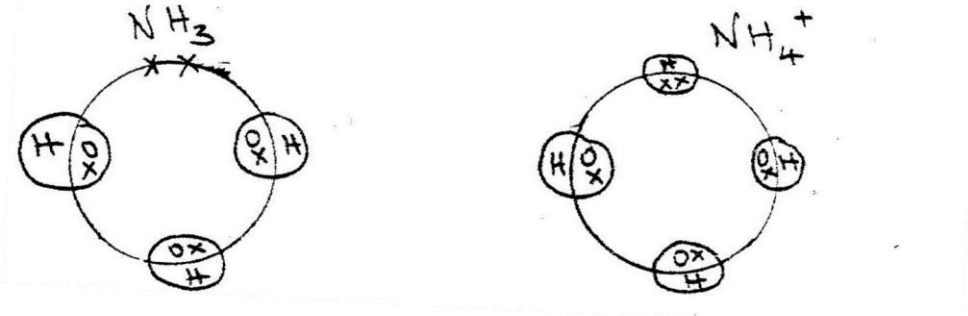
Nine was in excess

b) Moles of H_2 produced = 0.01

Volume = 22.4 x 0.01 = 0.224 litres or 224 cm^4

4. a) increase in temperature would lower the yield of Nitrogen, this is because the reaction is exothermic and equilibrium shift to the left.



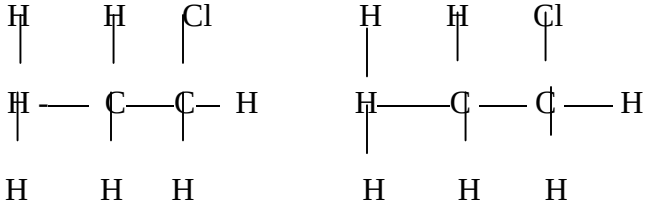
5. 

It has a lone pair of electrons which it uses to form a dative bond with H ions (1mk)

6. a) G
b) E

7. a) U-V Light/ sunlight

b)



8. Sulphur dioxide, it reacts with limewater being an acid gas

9. Add solid hydrogen carbonate; CH_3COOH produces effervescence; while $CH_3CH_2CH_2OH$ does not (Accept any other carbonate that behaves

10 The ionic end lowers the surface tensions of water , facilitating mixing while the non- ionic end (non-polar end) mixes with grease, dislodging it from the fabric.

11. Number of neutrons =1
Number of electrons=1

12 $2mg_{(s)} + O_{2\,(g)} \longrightarrow MgO_{\,(s)}$
$3Mg_{(s)} + N_{2\,(g\,)} \longrightarrow Mg_3N_{2(s)}$

13. I, production of carbon dioxide or carbon is oxidized to its highest oxidation number/ carbon dioxide cannot burn further or carbon dioxide cannot burn further or carbon monoxide can burn further.

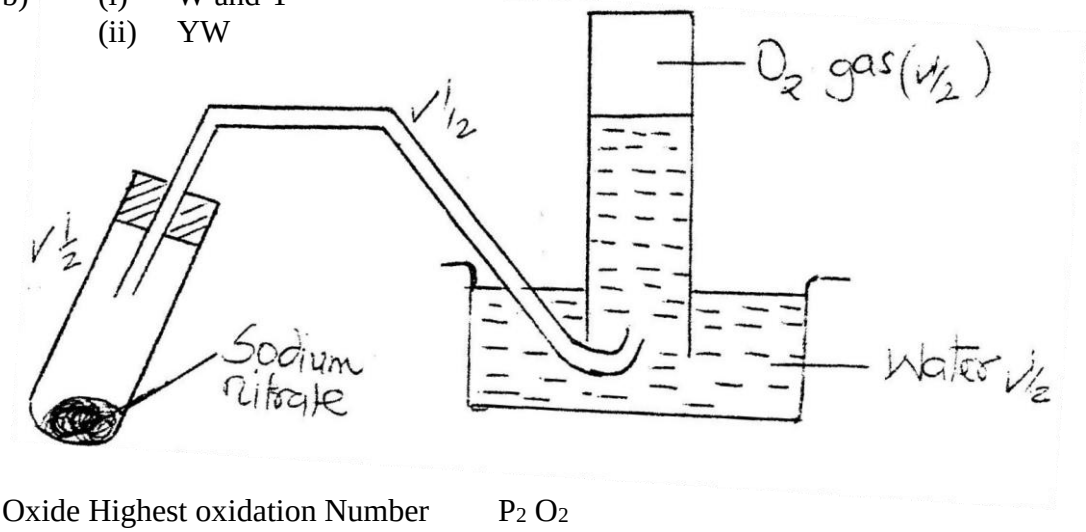
14. Increase in pressure would shift the equilibrium to the left; since in pressure favors the reaction will produce less volume of gas.

15. a) X, both energy levels are full i.e 2:8 outer energy level full/has octane structure/inert gas structure.

b) (i) W and Y

(ii) YW

16



17. Oxide Highest oxidation Number P_2O_2 C_2O_7

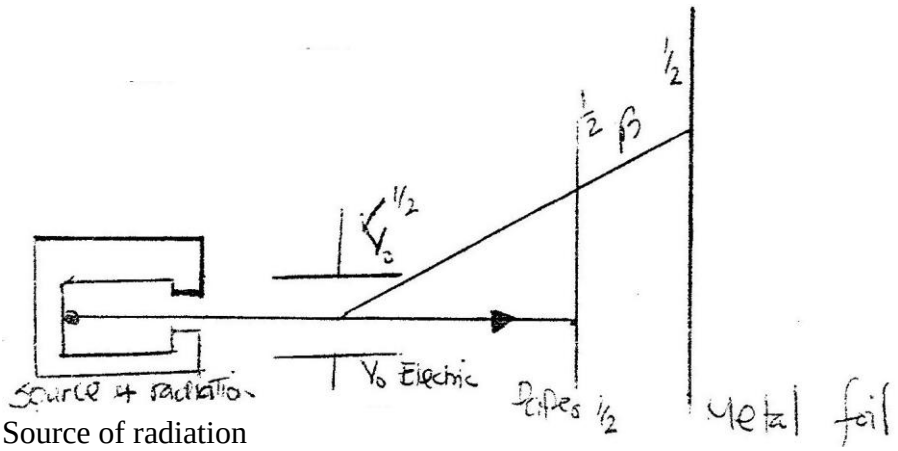
18. Sodium chloride will remove Pb from the insoluble pbC12. This affects the value of the cell voltage.

19. a) The energy change that takes place when one mole of the compound is formed from its constituents elements in their state

b) 3x-286 = 2x-394-(277)

858 + 788+ 277 = 11369kjmol

20.



Source of radiation
For electric or magnetic field

For showing how α and β are attracted

For showing how α stopped by paper, β by metal foil.

21. a) The colourless solution would turn brown, chloride displaces iodine from iodine solution

$$C_{2(g)} + 2I_{(aq)} \longrightarrow C\ (aq) + I2_{(aq)}$$

b) Covalent, because elements are non-metals

22. a) $Li(s) + 2H\square O(s) \longrightarrow 2I\ (aq)$

b) Potassium is very reactive; and so the reaction is likely to be very violent

23. Dissolve in water, filter to remove lead carbonate as a residue, evaporate filter to saturation and allow to cool. Crystallization to take place. Filter the crystals and dry. Evaporate to dryness.

24. a) H2S because it is oxidized by losing hydrogen/oxidation number s us increased from -2 to 0. Cl2 is reduced form 0 to -1.

b) Theoretical yield of S = $2.4 \times \frac{100}{75} = 3.2g$

Mole of H2S(g) = Moles of S(s) = $\frac{3.2}{32} = 0.1mol$

25. Monomer CH2 = $\begin{vmatrix} \\ \\ \end{vmatrix}$ CH

CH

R.M.M of monomer = 36+3+14 =53

No. of monomer = $\frac{5194}{53}$

26. (a) (i) Iron (II) nitrate solution – turns lead acetate paper black/give yellow solid with SO_3 amphoteric/soluble both acids and bases.

29. $CO(g) + PbO_{(s)} \longrightarrow Pb(s) + CO_2(g)$

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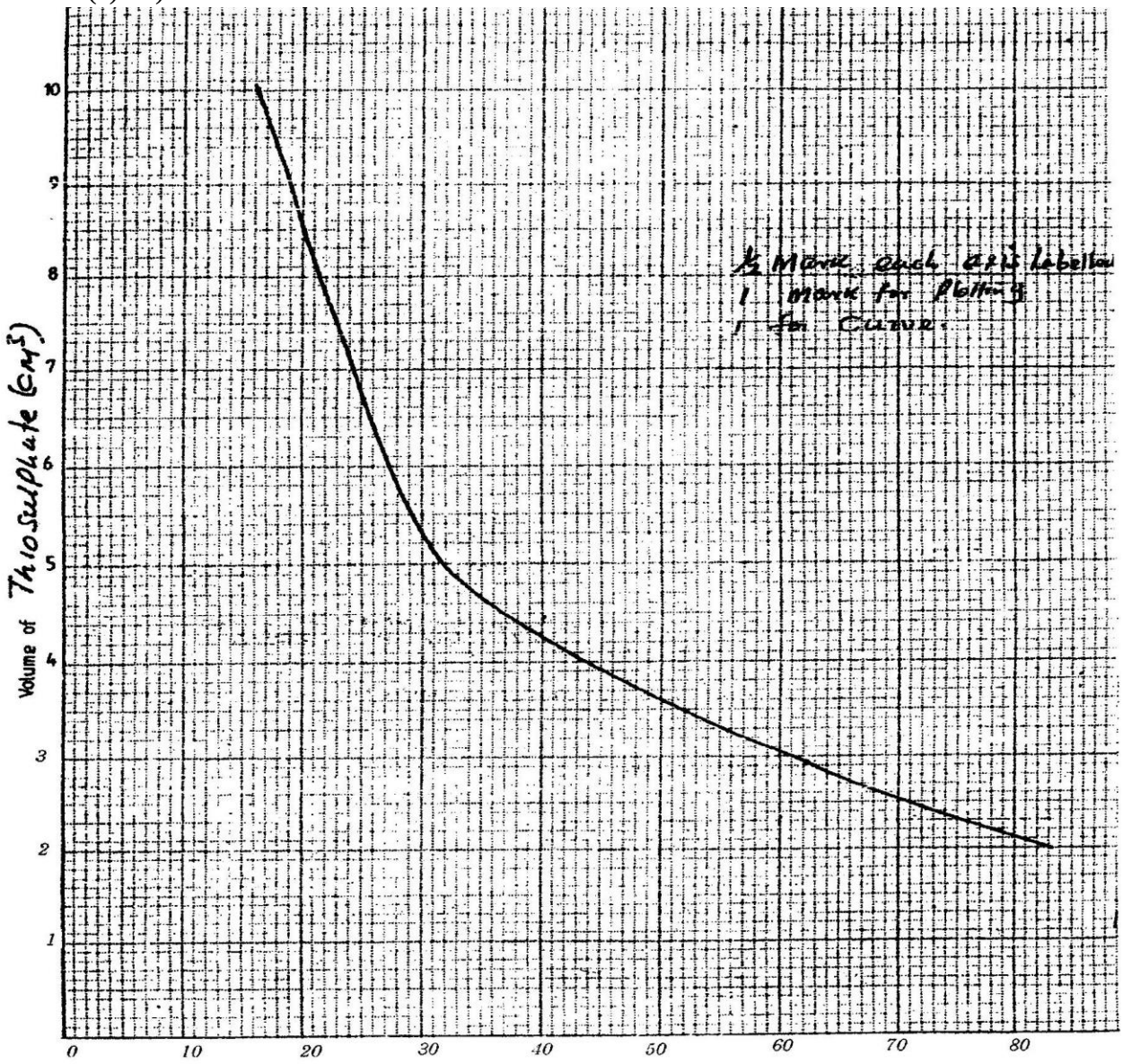
1. (a) i)



ii) I. 27-28 seconds (1mark)

II 54- 56 seconds (1 mark)

(Answers should also be read from the graph concentration in part II is half that of part I)

b) (i) I Moles of thiosulphate = $\frac{10}{1000}$ x 0.4 = 0.004 moles

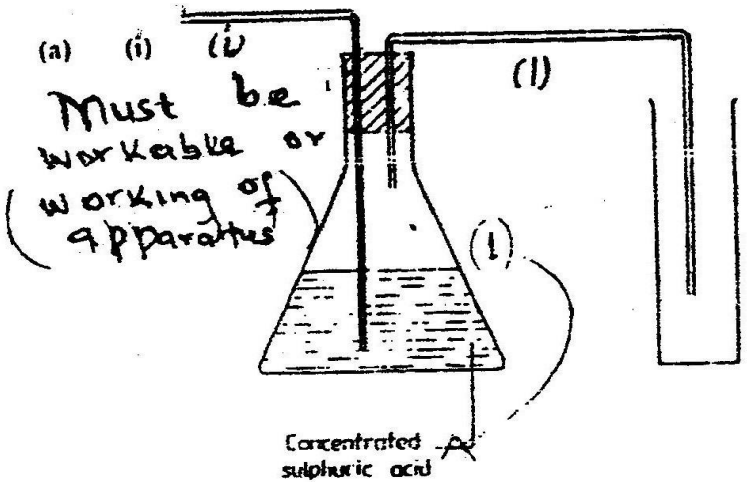
II Moles of hydrochloric acid = $\frac{10}{1000}$ x 2 = 0.02 moles (2 mks)

(ii) Thiosulphate – hydrochloric acid is in excess (1 mark)

c) Same across should be used in each experiment (1 mark)

Cross should be viewed from the same position (1 mark)

2. a) (i)



(ii) MnO_2 is reduced

In MNO_2 Mn has oxidation +4 where as on $MnCl_2$ it has oxidation number +2 (2mks)

(iii) To remove HCL fumes/ absorb as/spray (1 mk)

b) (i) X- Oxygen (do not allow chlorine) (1mk)

Y- Hydrogen (1mk)

(ii) Water is a poor electrolyte when HCL gas dissolves in form hydrochloric acid which is an electrolyte.

(2mks)

(iii) $4OH^-_{(aq)} \rightarrow O_2(g) + 2H_2O(l) + 4e$

OR

$4H^+_{(aq)} + 4e \rightarrow H_2(g)$ (1mk)

b) (i) X-Oxygen (do not allow chlorine) 1mark)

Y- Hydrogen (1mk)

(ii) Water is a poor electrolyte when HCL gas dissolves in form hydrochloric acid which is an electrolyte. (2mks)

(iii) $4OH^-_{(aq)} \rightarrow O_2(g) + 2H_2O(l) + 4e$

OR

According to the equations the gases are produced in the ratio (2mks)

$O_2 : H_2 = 1:2$ (2mks)

3. a) (i) Bauxite (1mk)

(ii) Iron (III) Oxide/ silicon (IV) / silicon dioxide/ silica (1mk)

b) (i)

(ii) I. It is uneconomical/ expensive, because a lot of energy is required to produce this high temperature.

II. Addition of cryolite

(iii) The melting point is below 8000C.

C) Quantity of electricity = 40,000 x 60 x60 coulombs.

3x96, 500 coulombs of produce 27g of Al

40,000x 60 x 60 x27

3x 96,500x 1,000

= 13.4kg.

4 a) C=6, H=1, Na= 11, Ne = 20.

b) Ca+ 2, 8, 8

p3- 2, 8, 8

c) -259 + 273 = 14k.

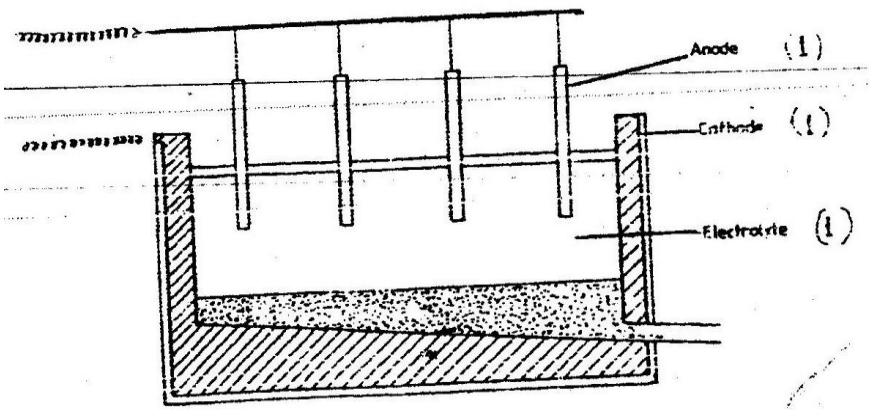
d) Red phosphorus this is because it has a higher melting point.

e) The one of atomic number 24 because it is closer to the R.A.M (24.3) that means it contributes to R.A.M more than the other two (2mks)

f) Al4C3 (1mk)

g) The melting point of a magnesium is higher than of sodium because its effective nuclear chare is higher/ it contributes more electrons to the metallic bonding as compared to Na which contributes/magnesium has 2 outer electron(+2) where as sodium has only one(+1) which can be delocalized. (2 mks)

5. a) i) $C_2H_4O_2$. Its M.P is higher than 10^oC



ii) C_5H_{12} and C_6H_{14}

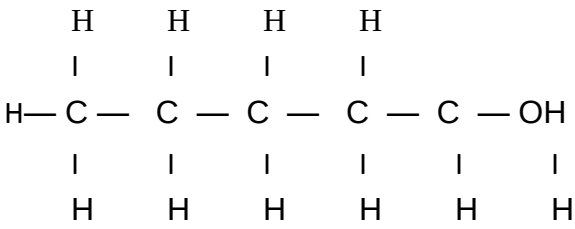
C_6H_{14} has a higher M.P therefore stronger van der waal force / intermolecular forces.

iii) C_3H_8O is more soluble in water than $C5H_{12}$ because it forms hydrogen ` bonds with water molecules OR because it is polar due to the presence of OH / OH mixes with water (Hydrogen bond if formed)

b) i) C_4H_8

ii) $C_4H_8 + 6O_2 \longrightarrow 4\ Co_2 + 4\ H_2O$

c) i)



ii) Concentrated sulphuric acid / Al_2O_3 / Concentrated phosphoric acid.

Heat (160 – 180^oC)

d) i) Saponification / Hydrolysis. (1mk) ii) Esters / fats (1mk)

6. a) i) Hygroscopic / Hygroscopy (1mk) ii) Deliquescent / Deliquescence (1mk) iii) Efflorescent / efflorescence's (1mk) b) i) $Zn(OH)^{2+}{}_4$

ii) $Cu\ (OH)_4{}^{2-}$

c) i)

Fe	O	S	H2O
20.2	23.0	11.5	45.3
56	16	32	18
0.36	1.44	0.36	2.52
1	4	1	6

Empirical formula $FeSO_4\ 7H_2O$

Empirical mass = (56+3+64+7(18)) = 278

Formula $FeSO_4\ 7H_2O$

ii) 6.95g =6.95 = 0.025 moles

0.05 moles in 50cm3 = $\frac{0.025 \times 1000}{250} = 0.1$

Concentration is 0.1 Mol^{-1} $\frac{6.95x1000}{278 \times 250}$

7. a) i) I) 18.8^oC (avoid 17.5^oC)

II) Solubility at 100oC is 153 – 154 in 100cm^3

Maximum mass in 15 litres = 154 x 15g.

ii) Solubility at 23^oC is 98g in 1,000cm^3

Moles of $SO_2 = \frac{98}{64} = 1.53$

Moles of NaOH = 2 x 1.53 = 3.06

Volume of 2M NaOH $\frac{3.06 \times 1000}{2} = 1{,}530cm^3$

b) i) I) $4FeS_{2(s)} + HO = (g) \longrightarrow 2FeO_{3(s)} + 8SO_{2(g)}$

II) $SO_3(g) + H_2SO_4 \quad H2S2O7(10)$

III) $H_2S_2O_{7(l)} + H_2O_{(10} \quad 2H_2SO_{4(l)}$ or $\xrightarrow[(aq)]{}$ ii) I) Excess to shift equilibrium position to the right increases yield of SO_4

Or produces more SO_3 / complete oxidation of SO_2

II) Vanadium (V) oxide / platinum or V_2O_5 / Vanadium pentoxide.

CHEMISTRY PAPER 233/1 K.C.S.E 1997
MARKING SCHEME

1. - Iron wool turns or rusts due to formation of hydrated iron (III) oxide
   - Level of water inside the tube rises to occupy the space left by oxygen - Level of water in the beaker will fall

2. - Kerosene floats on water therefore it continues to burn
   - Carbon dioxide blanket covers the flame OR cuts off the supply of oxygen

3.

Name of polymer	Name of monomer	One use of the polymer
Polystyrene	Styrene (Phenylethene)	Insulation, plastic pipes, Biros, Artific rubber, care tyres manufacture of plas
Polymhyl chloride Polychloethane polychoeroethane	Vinyl chloride (chloroethane)	Insulation of electric cables, plastics, p cups, pipes, making plastic tiles, plastic shoes, water tanks

4. - K^+, / Na^+ / (Lit) and CO_3^{2-}

5. - B

   Give a reason

   - B does not form scum / A forms scum
   - B is soapless detergent

6. (a) - White solid/ white ring/ white substance

(b) - Nearer to HCI than to NH_3

NB. Not to touch the cotton wool

7. (a) - Time taken for a given mass of radioactive isotope to reduce to Half

(b) No. of t ½ = $\frac{100}{25} = 4$

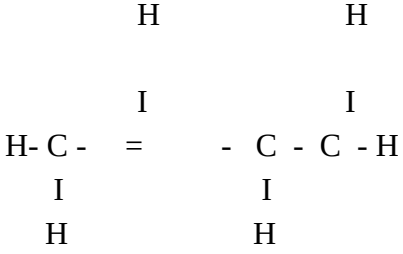
$\frac{5}{M} = (\frac{1}{2})^4 = M = 80g$

8. (a) $C_2H_3 = 27$

$27n = 54$

$n = 2$

MF = $(C_2H_3)_2 = C_4H_6$



(c) Alkyne/ Alkene

Depending on the structure

9. (a) - Barium Sulphate ($BaSO_3$)

(b) - $BaSO_{3(s)} + 2HCI\ (aq) \rightarrow BaCI_{2(aq)} + SO_{2(aq)}$

(c) - Changes from orange to green

10. (a) - $Pb^+\ (aq) + SO_4^{2-}(aq) \rightarrow PbSO_{4(s)}$

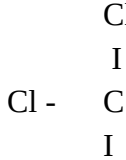
(b) RFM of $PbSO_4 = 207 + 32 + (16 \times 4) = 303$

0.63g pf Pb are in $\frac{303}{207} \times 0.63$

$= 0.92g$

11. - Aluminum chloride is covalent while magnesium chloride is ionic

12. - Tetrachlomethane/ carbon tetrachloride



Cl

13. (a) ΔH_1 – Bond breaking/ activation Energy

ΔH_3 – Energy evolved during reaction

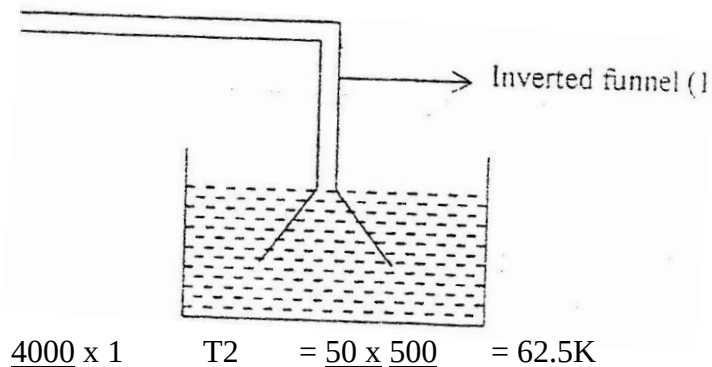
(b) - $\Delta H_3 = \Delta H_1 + \Delta H_2$

14. (a) - Yellow solid formed/ yellow substance/ sulphur deposited

(b) - $_2S(g) + Cl_2(g) \rightarrow 2HCl(g) + S(s)$

(c) - In a fume cupboard/ in open air

- Both $H_2S(g)$ and (g) are poisonous gases (They have irritating/ pungent smell)



Cl_2

$\frac{4000}{} \times 1$ T2 $= \frac{50 \times 500}{}$ = 62.5K

15.

16. - $\frac{0.5 \times 100}{T_2} = \frac{}{500} \quad \frac{}{400}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{1 \times 400}{500} = \frac{0.5 \times 100}{T_2}$

$T_2 = \frac{0.5 \times 100 \times 500}{400}$

T_2 = 62.5 K

17. - $H_2O(l)$ – It accepts a proton (H+) forward r x n

- or HO_2 – it accepts a proton (H+) Backward r x n

18. (a) - Fe^{3+}

(b) - Oxidizing/ oxidation property

(c) - $2Fe(OH)_3(s) \rightarrow Fe2O_3(s) + 3H_2O(g)$ or (l)

19. (a)- $Ca(OH)_2(aq) + Ca(HCO_3)_2(aq) \rightarrow 2CaCO_3(s) + H_2O(l)$

(b) Moles = $\frac{\text{Volume x Morality}}{1000}$

Moles of CO^{2+} = $\frac{90 \times 0.01}{1000}$

= 0.009 moles

(c) - It forms scum initially then produces lather - All the Ca^{2+} had not been precipitated.

- Water was still hhard

20. ΔH = 500 x 9 x 4.2

ΔH = 18900J

18900J produced by $\frac{0.6 \times 38000}{18900}$

= 12.06

21. - (a) To generate stream which pushes out air

(b) The air would oxidize zinc oxide no gas would be obtained

(c) It is less than air

22. (a) - Thermometer should not be dipped in the mixture thermometer be at outlet point of condenser

- The direction of water flow is wrong/ condenser wrongly fixed
- Named flask used/ No water bath is used

(b) - Boiling point/ Freezing point

- Density / refractive index

23. a) - period 3 / Third period

- Y^{3-} / p^3
-

Ionic radius is large – Atomic radius smaller

- Incoming electron repelled by electron in shell / energy level.

24. a) Cathode - Hydrogen

Anode - Oxygen

b) - It increases

c) - There would be an explosion potassium is very reactive.

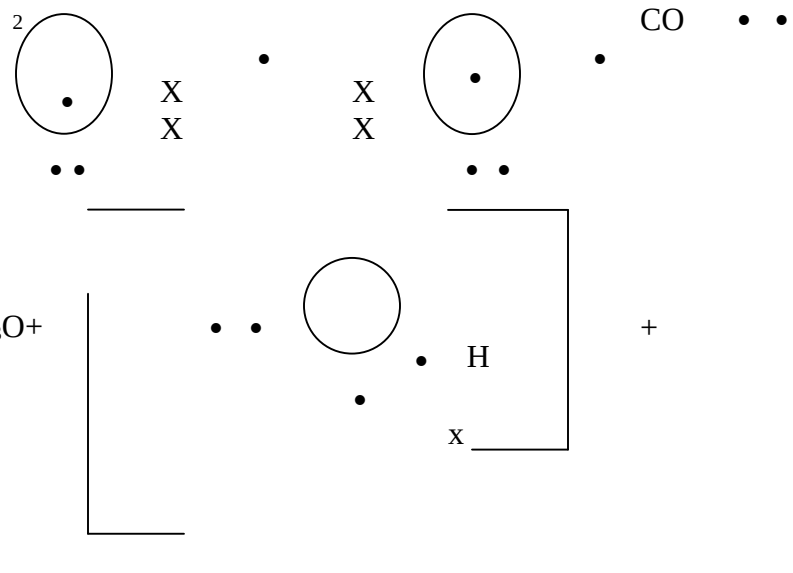
- It would react with the solvent.

25. TQRL / LRQT AND LRQT

26. a) -pbO, ZnO, pbO_2, SnO,Sno_2,Al_2O_3

b) pb ($OH0^{2-}{}_4$, $Zn(OH)^{2-}{}_4$, $Zn(OH)^{2}{}_{-4}$, Na_2pbO_2,$NaZnO_2$,
$NaAlO_2$, $NaSnO_2$

27. a)



b) H_3O^+

X

28. - No. of moles of hydrogen H_2 = $^{10}/_2$ = 5 Moles No. of moles of Nitrogen dioxide NO_2 = 46

Relative molecular mass of NO_2 = 46

1 Mole of No_2 = 5 x 46

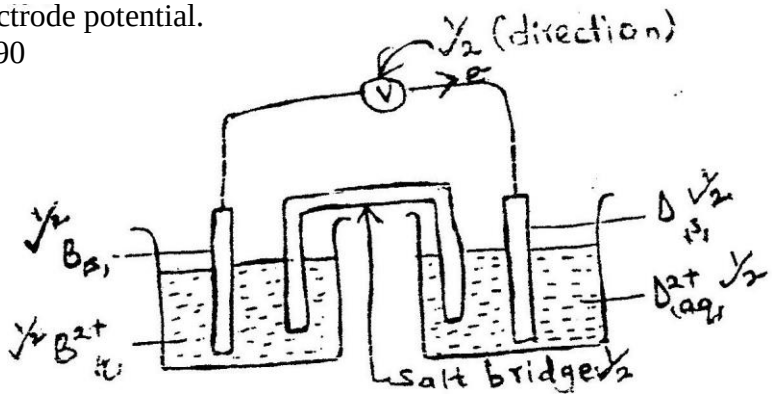
5 Moles = 30g

CHEMISTRY PAPER 233/2 K.C.S.E 1997 MARKING SCHEME.

1. i) C / C_2 Hydrogen is used as the reference electrode/ E^{θ} value is 0.000 / standard electrode potential.

ii) -2.90

iii)



iv) 2.38 + 0.34 = 2.72

OR

0.34 – (- 2.38) = 2.72

b) i) $CU_{(S)} \longrightarrow CU^{2+}(aq) + 2e$

OR

$CU(S) + e \longrightarrow CU^{2+}_{(aq)}$

ii) 0.2 x 5 x 60 x 60 ½ 0.2 x 5 x 60 x 60 x 63.5 = 3600 coulombs.

63.5g Cu requires 2x96500 2 x 96500

3600 C produce $\frac{63.5 \times 3600}{2 \times 96500}$ = 1.18gm

2. a) i) Buta – 1 – ol

ii) Propanoic acid

iii) Ethylethanoate.

b) i) CnH2n n = No. of carbon atoms ii) 70(not 70g if g = ½ mk) iii) C_5H_{10}; $Ch_3CH = CHCH_2$ CH $CH_3CH = C – Ch_3$ c) i) Step I……Hydrogen

Step II …….. Hydrogen chloride gas. / $HCl_{(g)}$

Step III …….. NaOH / soda lime / sodium hydroxide

ii) $2CH_{(g)} + 5O_{2\,(g)} \longrightarrow 4\,CO_{2\,(g)} + 2H_2O_{(g)}$

iii) Environmental pollutant

It is not biodegradable / decomposed by bacteria. 3.

i) G, H, L ($^1/_2$ Mk if 2)

Reason = Have a 1, 2,2 e'd respectively in outer orbit / their

Chlorides have a high M.P easily looses e,s / outer orbital have less than 4 e's.

ii) HK or Mgs (not KH or smg)

iii) J has strong covalent bonds / has a giant covalent / atomic structure / weak van der waals between molecules.

iv) +4 /4-

v) I – M.p of fluoride of G is higher because fluorine is more reactive than chlorine / forms stronger ionic bonds G than chlorine/Flourone is more electronegative II – reactivity of L is higher. Reactivity within metallic group increases down the group and L is below H. L looses e's easily // L is more electropositive.

4. a) (i) - To lower M.P of NaCl from 800-600^{0}C hence reducing the cost of production of Na.

(ii) - Steel would react chlorine while graphite will not.

(ii) - M.P lower than that of the electrolyte

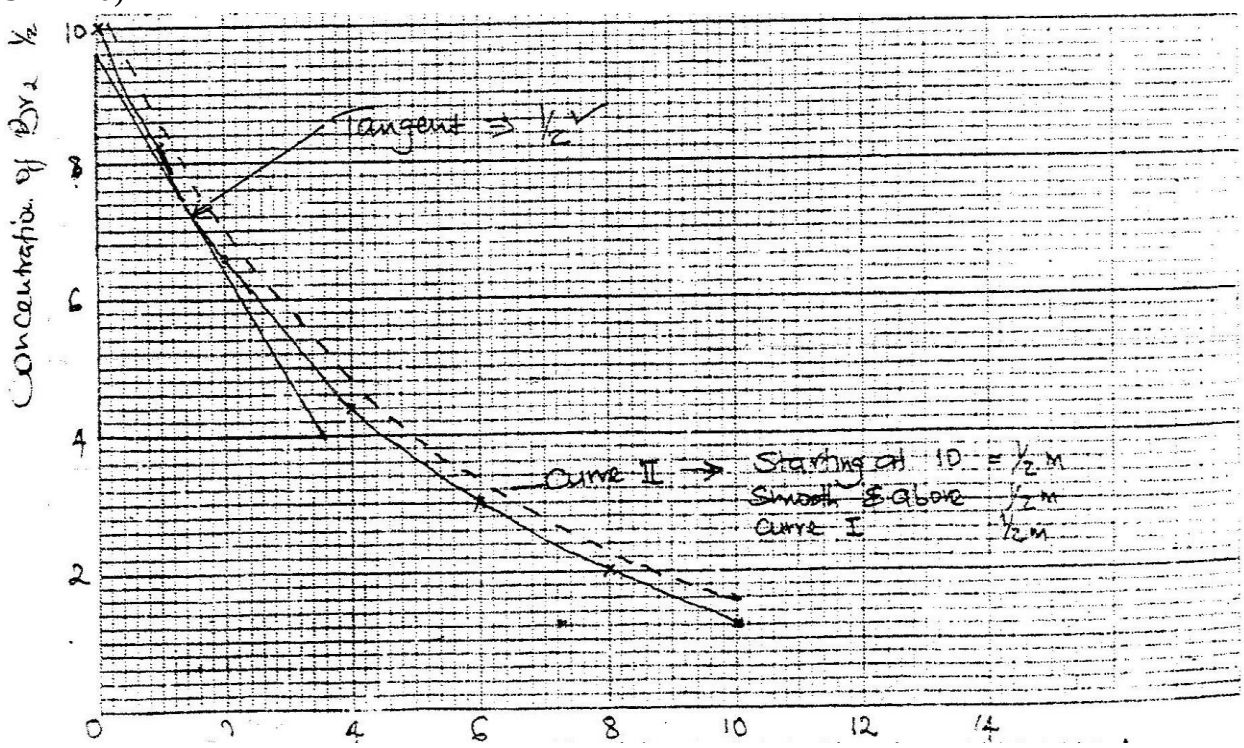
- Less dense than that of the eleactrolyte

(iv) - To prevent the chlorine and sodium from mixing / coming into conduct/ prevent products from mixing.

(v) I Cathode Na+ (i) +e- Na (l) —H► Anode 2Cl- (l) $Cl_{2\ (g)}$ +2e-►

(i) Manufacture of Na2O2, NaCN / alloy of Na + Pb to make T.E.L / Liquid Na – coolant in nuclear reactors / Na vapour used in extraction of titanium. (b) To prevent from reacting with air and water.

5 a)



(b) (i) 5.3x103 moldm3 (units not necessary/do not penalise)

Change in conc. = (9.6 -4) x 103 = 5.6 x 103

Change in time = 3.7-0 =3.7 min

Rate of reaction $\frac{5.6}{3.7}$ = 1.51 x 103

(C) At high concentration the rate of reaction is high because the more particles in solution collide at high frequency.

(d) At lower temps; the particles have les K.e / frequency of collision is reduced/ few particles/ less activation energy.

6. (a) (i) Anhydrous /fused CaCl /CaO /quick lime

(ii) To remove CO_2 $\longrightarrow$ $2Fe\ O_3\ (s)$

(iii) $4Fe(s) + 3O2_{(g)} \longrightarrow 3Fe(s) + 2O2_{(g)}$ $Fe3\ O4_{(s)}$

(iii) Argon // Helium// Krypton // Neon

(iv) Provide low temperature so that semen does not decompose// destroyed (low temp. tied with storage// decompose/destroyed.

b) (i) Conc. Sulphuric acid.

(ii) $NaNO_{3(s)} + H2SO4(l) \longrightarrow NaHSO_4(s) + HNO_{3(g)}$ //

$NaNO_{3(s)} + H2SO4(l) \longrightarrow Na2SO_4(s) + 2HNO_3$

(iii) I To avoid decomposition of nitric acid by sunlight/light

II Copper react with 50% Nitric acid to form colourless NO_2 then NO react with O_2 to form brown fumes of NO_2.

a) 1 mole $NHa4NO_3$ is formed from 1 M of NH_3

80Kg of $Nh4NO_3$ is formed from 17Kg NH3

4800 Kg of NH_4NO_3 requires $\frac{17x4800}{80}$ kg

= 1020Kg (penalise ½ mk if units are missing or wrong.

7. a) (i) To remove excess / unreacted HCL gas.

(ii) S

$2HCl(g) + \longrightarrow Zn(s)\ ZnCl_2(s) + H_2(g)$

$PbO(s) + H_2(g) \longrightarrow Pb(s) + H2O\ (g)$

(i) Mass will be lower at the end of the experiment because the combined O_2 in PbO is removed/reduced.

b) (i) I To produce HCl gas /$HCl_{(g)}$

II To oxidize $HCl_{(g)}$ to chlorine gas/produce chlorine gas.

(ii) Sodium hypochlorite/ NaOCl / Sodium chlorate

(iii) Kill germs /disinfectant/antiseptic

c) $MgCl_2$ requires 2 mol of Ag.NO3

Moles of $MgCl_2$ $= \frac{1.9}{95} = 0.02$

Moles of AgNO3 $= \frac{1.9}{95} \times 2 = 0.04$

R.F.M of AgNO3 = 170

Mass of AgNO3 $= \frac{1.9x2x170}{95} = 0.04x170$

= 6.8 gm

CHEMISTRY PAPER 233/1 K.C.S.E 1998
MARKING SCHEME

1. (a) - $234U \rightarrow 230Th + 4He$

(b) - Gamma rays will penetrate through the walls of the container and causes damage

2. - Add water to the solid mixture A dissolves while B does Not
   - Filter the mixture
   - Evaporate the filtrate to dryness

3. **Advantage**
   - Prevents knocking engines
   - Prevent premature ignition
   - Increase the Octane rating (Number)

Disadvantage

- Poisonous lead or lead compounds are released into the environment/ pollutes the atmospheres

4. (a) $|\ Al(s)\ |\ Al^{3+}(aq)\ ||\ Fe^{2+}(aq)\ |\ Fe(s)\ |$

EMF = E^{θ}_{R}. $E^{\theta}O$

= (-0.44) – (-1.66) = 1.22V

(b) - It is always on the left cell rep

- Correspond on iron/ element lower in E.C.S of the two
- Has less negative

5. (a) ---------- 6

(b) ---------- 28

6. ALT 1

$CxHy + O_2$ x $CO_2 + {}^{y}/_{2}\ H_3O$

$XCO_2\ {}^{y}/_{2}\ H_2O$

3:52 1:44

r:3.52 ____ = 0.08 ____1.44 = 0.08
44 44

= $\underline{0.08}$ =1 $\underline{0.08}$ = 1
0.08 0.08

X = $1\ {}^{y}/_{2} = 1$

=E.F = CH_2 y = 2

E.F.M = 14

N= $\underline{56}$ =4
14

M.F. $(CH_2)_4 = C_4H_8$

Mass of C = $\frac{12}{44} \times 3.52 = 0.96$

Mass of H = $\frac{2}{18} \times 1.44 = 0.16g$

Moles of C = $\frac{0.96}{12} = 0.08$

Moles of H = $\frac{0.16}{1} = 0.16$

Ratio 0.08 : 0.16

0.08 : 0.08

1 2

EF : CH_2

N : 4

MF = $(CH_2)_4 = C_4H_8$

7. (a) SO_5^{2-}

NH_4^+

(Acc. Sulphate ions, ammonia ions)

(b) From ammonia and sulphate based fertilizer

3. $FeCl_2$ oxidation No. of Fe increase from +2 to +3

Or oxidation No. of Cl_2 decreases from 0 to -1

4. (a) – Rxn where the rates of forward and backward rxns are the same

(b) – The mixture becomes more yellow reasons: The equilibrium Position Shifts/ moves to the right since more OH- ions have been added

5. 16N

15P

6. (a) In Diamond all the C- atoms are joined together by covalent in a three dimensions (3 –D) structure/ Tetrahedral structure thus very hard

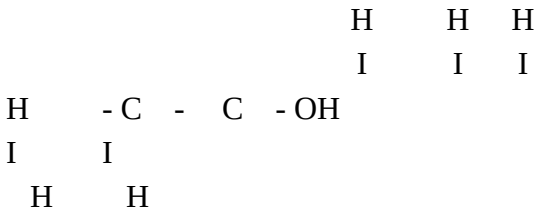
(a) The C- atoms in graphite are bonded in layers/ hexagonal strata's, those thus slide over one another easily.

7. Strong acid - one which is fully dissociated when in water e.g HCI, Hi, Hi, HBr
Weak Acid: one which is partially dissociated when in water e.g. CH_3COOH

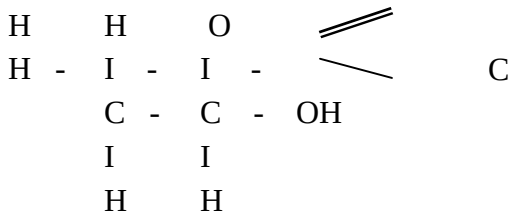
8. (a) Because concentration of Cu^{2+} is high at the beginning and decreases as the ions are discharged during electrolysis

(b) Cu^{2+} (aq) + 2e = Cu(s)

9. (a) Ethanol



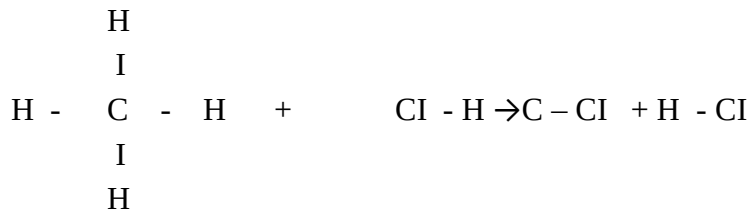
(b) Propanoic



(c) – Ethylpropanoate

10. (a) (i) - F
(ii) - I
(b)

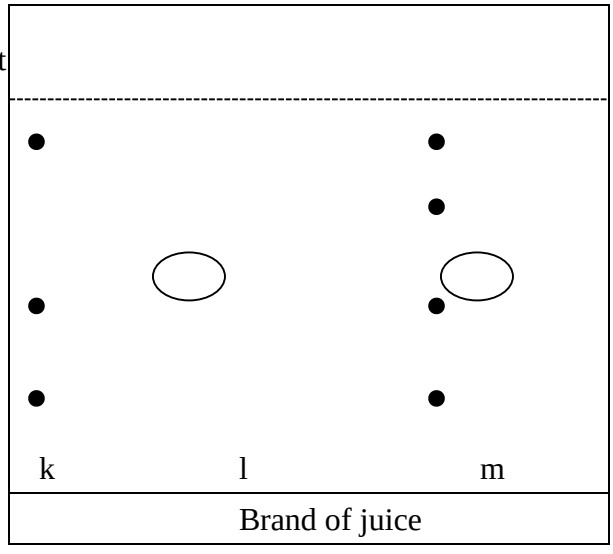
11. $CH_4(g) + CI_2(g) \rightarrow CH_3CI(g) + HCI(g)$



$\underline{414 + 244}$ = $\underline{326 + 431}$
BBE 658 BFE 757

ΔHd = BBE – BFE = 658 – 758 = -99KJ
ALT2
4(414) + 244 = 3(414) + 326 + 431
BBE 1900 – 1999 = -99KJ

12.



13. ALT 1
RMM of $(NH_2)CO$ = 28 – 4 + 16 = 60
$NH_3^2 : (NH_2)_2CO$
2 x 17kg 60kg
680 kg = $\frac{60\text{ kg} \times 680}{2 \times 17}$ = 1200kg

ALT 2

Moles: 680000g = 40,000 moles, 40,000 = 20,000 moles
17

Mg = n x R.F.M
20,000 x 60
1200000g
1200kg

14. **ALT 1**

- Add dilute HNO_3 to the carbonate - Allow the rxn to go to completion
- Add excess dilute HCI to the mixture
- Filter

15. I. $C(s) + O_2(s) \rightarrow CO_2(g)$ II $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

16. (a) Polystyrene or polyphenylethene

17. (a) Zinc/Zn

(b) $Zn(NH_3)_4^{2+}$

18. $P_1 + P_2$ Vol is constant
T_1

$\frac{760}{273} = \frac{P_2}{373}$ $P_2 = \frac{760 \times 373}{273} = 1038 \pm$ mmHg

19. Sting from a bee contains an acid which causes irritation
$NaHCO_3$ being alkaline neutralizes the acid

20. R- Melting/ fusion
V- Boiling/ vaporization
W – Condensation/ liquefaction
U- Freezing/ solidification

21. IV, II, I,III

22. Butane

H H H H

```
        I     I     I     I
H       -     C  -  C  - C  - C  - H
I       I     I     I
        H     H     H     H
```

23. (i) The Ca^{+}, Mg^{2+} ions in water are exchanged with Na^{+} ions in the permutit

(ii) By passing a solution of Conc. Sodium chloride through the Column

(iii) Provides Ca^{2+} required for teeth and bones formation

It coats lead pipes insides hence preventing lead poisoning

24. $x + 4(-2) = -1$ $x - 8 = -1$ $x = 7$

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MARKING SCHEME

1. (a) – To a sample of the ore add dilute sulphuric acid or hydrochloric acid (I) and warm (½)
   - Filter the mixture (½)
   - To a portion of the filtrate, add sodium hydroxide or ammonium hydroxide drop wise until in excess (½)
   - Formation of the dirty green precipitate (½) OR
   - To a portion of the filtrate, add sodium hydroxide or ammonia hydroxide drop wise until in excess (I) formation of brown precipitate (½) shows presence of Fe^{3-} (½)

(b) (i) Mass of oxygen = 13.30 – 12.66 = 0.64(g) (½)

Mass of iron = 12.66 – 10.98 = 1.68 (g) (½)

$\frac{168}{52} = 0.03$ $\frac{0.64}{16} = 0.04$

Rate of moles Fe: O = 3:4(½)

Molecules formula = Fe_3O_4(I)

(ii) $Fe_3O_4(S) + 4CO(s) \rightarrow 3Fe(s) + 4CO_2(g)$

(c) (i) Oxygen (½), water (½)

(ii) Galvanizing, painting, electroplating e.t.c

(d) Seawater contains ions (I), which accelerate the rate of corrosion

2. (a) (i). Polymerization

(ii) Substitution (I) (accept chlorination)

(b) (i) distillation

(ii) – Sodium metal disappears/ dissolves/ clarts around (½)

- Bubbles of a colourless gas/ effervescence (½) beaker become warm

Sodium metal reacts with ethanol to produce hydrogen gas (I)
The reaction is exothermic/ heat is evolved

(iii) Fuel/gasoline
- Solvent
- Starting material for manufacture of P.V.C, etheneglycol e.t.c
- Skin disinfect/ antiseptic
- In thermometer/ in making alcohol thermometers

(c) (i) Name: Propane
Structural formula

(ii) Bromine water is decolourised (I) because is unsaturated (I) or has a double bond

(iii) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(I)$

3. (a) (i) Fractional distillation

(ii) Neutralization

(b) - Electrolysis of brine (c) - High pressure brings the molecules closer/ increases the concentration of gas molecules (I)The pressure shifts the equilibrium to the right hence the yield of ammonia (product) increases.

(d) $2NH_3(g) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$

(e) Platinum or Rhodium
Reagent
Water (½), Oxygen (½)

(f) Ammonium nitrate / NH_4NO_3

(g) Fertilizer

4. (a) Remove oxygen (I) which could react with the element to form an oxide

(b) absorb excess chloride
- Absorb moisture from the atmosphere

(c) Sodium chloride has a high melting point (I) and the burner flame Temperature is not able to vaporize sodium chloride

(d) Calcium oxide OR quick lime/ CaO

(e) $2P(s) + 3CI_2(g) \rightarrow 2PCI_3(g)$ $P_4 + 6CI_2(g) \rightarrow 4PCI_3(I)$

(f) – Heat the mixture
- Aluminium chloride sublimes
- Cool to obtain aluminium chloride
- Sodium chloride is left in the vessel

5. (a) (i) - Scale (I)
- Plotting all points correctly (I)
- Curve (shape)

(ii) 0.188 – 0.12 = 0.068 mol (I)
Therefore mass of hydrated copper (II) sulphate
= 0.68 x 250 = 17g

(b) (i) Moles of $AgNO_3$ = $\frac{0.1 \times 24.1}{1000} = 2.41 \times 10^{-3}$

(ii) Moles of NaCI = Moles of $AgNO_3$
= 241×10^{-3}

(iii) Moles of NaCI in $250cm^3 = 2.41 \times 10^{-3} \times \frac{250}{25}$

2.41×10^{-2}

(iv) R.F.M NaCI = 23 + 35. 5 = 58.5
Mass of NaCI in $5cm^3$ = 2.41 x 10-2 x 58.5
= 1.41g

(v) Mass of water = 5.35 – 1.41
= 3.94g

(vi) 3.94 of water contains 1.41g of NaCI
100g of water = $\frac{1.41 \times 100}{3.94}$
=35.7

6. (a) (i) To get uniform mixing of the reagents hence uniform distribution of heat

(ii) $H^+(aq) + OH^-(aq)\ H_2O(I)$ OR
$H_3O^+(aq) + OH^-(aq)\ 2H_2O(I)$

(iii) I. Complete neutralization takes place
II. Y_1 and Y_2 reactions is tacking place producing heat
Y_3 and Y_4 reaction has come to an end, the reaction mixture is cooling/loss of heat to environment

(iv) I.
$T=30.9 – 24.5 = 6.4^0C$
H = 200 x 6.4 (I) x 4.2 = 537 joules
II. moles of NaOH = $\frac{100 \times 1}{}$ = 0.1 moles

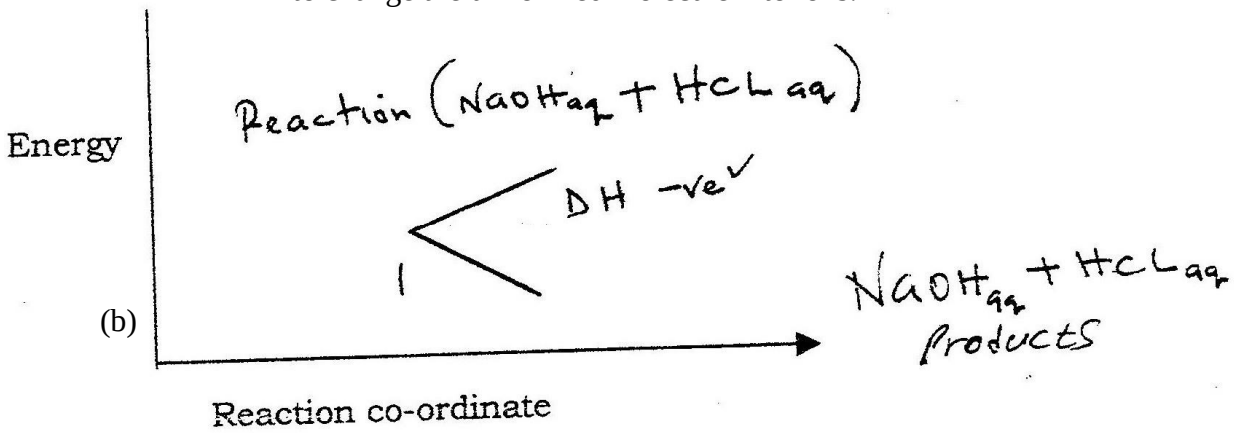
1000

0.1 moles = 5376 joules
therefore 1 mole = $\frac{5376}{0.1 \times 1000}$

$= 53.76 \text{ Kj mol}^{-1}$

(v) Lower (I), ethanoic acid is partially ionized. Some energy is used to change the un ionized molecule into ions.

(b)



7. (a) (i) S and W
(ii) T,U,V

(b) (i) V(I) it is the only element whose boiling point is below 298K
(ii) V

(c) (i) $T(NO_3)_3$
(ii) $2S + U \rightarrow S_2U$

(d) Ionic (I) T. Is a metal while U is a non- metal (½). Therefore T loses electrons to U. T is electropositive while U electronegative. (½)

(e) (i) Cathode
Hydrogen (I)
(ii) Anode
Oxygen (I)

CHEMISTRY PAPER 233/1 K.C.S.E 1998
MARKING SCHEME

1. (a) - $^{234}U \rightarrow ^{230}Th + ^{4}He$
(b) - Gamma rays will penetrate through the walls of the container and causes damage

2. - Add water to the solid mixture A dissolves while B does Not
- Filter the mixture
- Evaporate the filtrate to dryness

4. Advantage

- Prevents knocking engines
- Prevent premature ignition
- Increase the Octane rating (Number)

Disadvantage

- Poisonous lead or lead compounds are released into the environment/ pollutes the atmospheres

4. (a) $\left|\right.$ Al(s) $\left|\right.$ $Al^{3+}(aq)$ $\left|\right.$ $Fe^{2+}(aq)$ $\left|\right.$ Fe(s) $\left|\right.$

EMF = E^{θ}_{R}. $E^{\theta}O$

= (-0.44) – (-1.66) = 1.22V

(b) - It is always on the left cell rep

- Correspond on iron/ element lower in E.C.S of the two
- Has less negative

5. (a) -D

(b) -E

6. ALT 1

$CxHy + O_2$ x $CO_2 + {}^{y}/_{2}\ H_3O$

$XCO_2\ {}^{y}/_{2}\ H_2O$

3:52 1:44

r:3.52 ____ = 0.08 ____1.44 = 0.08
45 44

= 0.08 =1 0.08 = 1
0.09 0.08

X = 1 ${}^{y}/_{2}$ = 1

=E.F = CH_2 y = 2

E.F.M = 14

N= 56 =4
14

M.F. $(CH_2)_4 = C_4H_8$

Mass of C = 12 x 3.52 = 0.96
44

Mass of H = 2 x 1.44 = 0.16g
18

Moles of C = 0.96 = 0.08
12

Moles of H = 0.16 = 0.16

1

Ratio 0.08 : 0.16

0.08 : 0.08

1 2

EF : CH_2

N : 4

MF = $(CH_2)_4 = C_4H_8$

7. (a) SO_5^{2-}

NH_4^+

(Acc. Sulphate ions, ammonia ions)

(b) From ammonia and sulphate based fertilizer

25. $FeCI_2$ oxidation No. of Fe increase from +2 to +3

Or oxidation No. of Cl_2 decreases from 0 to -1

26. (a) – Rxn where the rates of forward and backward rxns are the same

(b) – The mixture becomes more yellow reasons: The equilibrium Position Shifts/ moves to the right since more OH- ions have been added

27. 16N

15P

28. (a) In Diamond all the C- atoms are joined together by covalent in a three dimensions (3 –D) structure/ Tetrahedral structure thus very hard

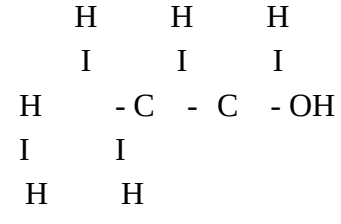
(b) The C- atoms in graphite are bonded in layers/ hexagonal strata's, those thus slide over one another easily.

29. Strong acid - one which is fully dissociated when in water e.g HCI, Hi, Hi, HBr
Weak Acid: one which is partially dissociated when in water e.g. CH_3COOH

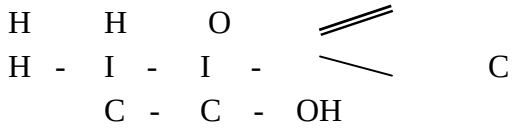
30. (a) Because concentration of Cu^{2+} is high at the beginning and decreases as the ions are discharged during electrolysis

(b) Cu^{2+} (aq) + 2e = Cu(s)

31. (a) Ethanol



(b) Propanoic



I I
H H

(c) – Ethylpropanoate

32. (a) (i) - F
(ii) - I

(b)

33. $CH_4(g) + CI_2(g) \rightarrow CH_3CI(g) + HCI(g)$

H
I
H - C - H + CI - H → C – CI + H - CI
I
H

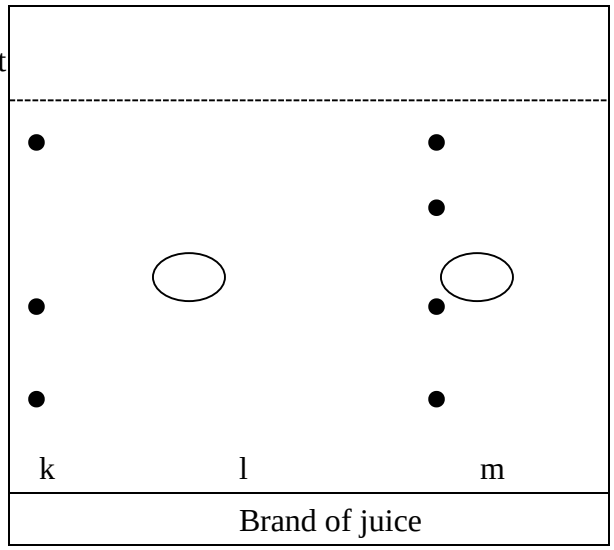
414 + 244 = 326 + 431
BBE 658 BFE 757

ΔHd = BBE – BFE = 658 – 758 = -99KJ

ALT2

4(414) + 244 = 3(414) + 326 + 431
BBE 1900 – 1999 = -99KJ

34.



35. ALT 1

RMM of (NH_2) CO = 28 – 4 + 16 = 60

NH_3^2 : $(NH_2)_2CO$
2 x 17kg 60kg

680 kg = $\frac{60 \text{ kg} \times 680}{2 \times 17}$ = 1200kg

ALT 2

Moles: $\frac{680000\text{g}}{17}$ = 40,000 moles, 40,000 = 20,000 moles

Mg = n x R.F.M
20,000 x 60
1200000g
1200kg

36. **ALT 1**

- Add dilute HNO_3 to the carbonate - Allow the rxn to go to completion
- Add excess dilute HCI to the mixture
- Filter

37. I. $C(s) + O_2(s) \rightarrow CO_2(g)$ II $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

38. (a) Polystyrene or polyphenylethene

39. (a) Zinc/Zn

(b) $Zn(NH_3)_4^{2+}$

40. $\frac{P_1}{T_1} + \frac{P_2}{}$ Vol is constant

$\frac{760}{273} = \frac{P_2}{373}$ $P_2 = \frac{760 \times 373}{273}$ = 1038 ± mmHg

41. Sting from a bee contains an acid which causes irritation
$NaHCO_3$ being alkaline neutralizes the acid

42. R- Melting/ fusion
V- Boiling/ vaporization
W – Condensation/ liquefaction
U- Freezing/ solidification

43. IV, II, I,III

44. Butane

```
H    H    H    H
I    I    I    I
H    -    C  -  C  - C  - C  - H
I    I    I    I
H    H    H    H
```

45. (i) The Ca^{+}, Mg^{2+} ions in water are exchanged with Na^{+} ions in the permutit
(ii) By passing a solution of Conc. Sodium chloride through the Column
(iii) Provides Ca^{2+} required for teeth and bones formation
It coats lead pipes insides hence preventing lead poisoning

46. x + 4 (-2) = -1
x – 8 =-1 x =
7

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MARKING SCHEME

8. (a) – To a sample of the ore add dilute sulphuric acid or hydrochloric acid (I) and warm (½)
- Filter the mixture (½)
- To a portion of the filtrate, add sodium hydroxide or ammonium hydroxide drop wise until in excess (½)
- Formation of the dirty green precipitate (½) OR
- To a portion of the filtrate, add sodium hydroxide or ammonia hydroxide drop wise until in excess (I) formation of brown precipitate (½) shows presence of Fe^{3-} (½)

(b) (i) Mass of oxygen = 13.30 – 12.66 = 0.64(g) (½)
Mass of iron = 12.66 – 10.98 = 1.68 (g) (½)
168 = 0.03 0.64 = 0.04
52 16
Rate of moles Fe: O = 3:4(½)
Molecules formula = Fe_3O_4(I)

(ii) $Fe_3O_4(S) + 4CO(s) \rightarrow 3Fe(s) + 4CO_2(g)$

(c) (i) Oxygen (½), water (½)
(ii) Galvanizing, painting, electroplating e.t.c

(d) Seawater contains ions (I), which accelerate the rate of corrosion

9. (a) (i). Polymerization
(ii) Substitution (I) (accept chlorination)
(b) (i) distillation

(ii) – Sodium metal disappears/ dissolves/ clarts around (½)

- Bubbles of a colourless gas/ effervescence (½) beaker become warm

Sodium metal reacts with ethanol to produce hydrogen gas (I)

The reaction is exothermic/ heat is evolved

(iii) Fuel/gasoline

- Solvent
- Starting material for manufacture of P.V.C, etheneglycol e.t.c
- Skin disinfect/ antiseptic
- In thermometer/ in making alcohol thermometers

(c) (i) Name: Propane

Structural formula

(ii) Bromine water is decolourised (I) because is unsaturated (I) or has a double bond

(iii) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(I)$

10. (a) (i) Fractional distillation

(ii) Neutralization

(b) - Electrolysis of brine (c) - High pressure brings the molecules closer/ increases the concentration of gas molecules (I)The pressure shifts the equilibrium to the right hence the yield of ammonia (product) increases.

(d) $2NH_3(g) + H_2SO_4(aq) \rightarrow (NH_4)2SO_4(aq)$

(e) Platinum or Rhodium

Reagent

Water (½), Oxygen (½)

(f) Ammonium nitrate / NH_4NO_3

(g) Fertilizer

11. (a) Remove oxygen (I) which could react with the element to form an oxide

(b) absorb excess chloride

- Absorb moisture from the atmosphere

(c) Sodium chloride has a high melting point (I) and the burner flame Temperature is not able to vaporize sodium chloride

(d) Calcium oxide OR quick lime/ CaO

(e) $2P(s) + 3CI_2(g) \rightarrow 2PCI_3(g)$ $P_4 + 6CI_2(g) \rightarrow 4PCI_3(I)$

(f) – Heat the mixture

- Aluminium chloride sublimes
- Cool to obtain aluminium chloride
- Sodium chloride is left in the vessel

12. (a) (i) - Scale (I)
- Plotting all points correctly (I)
- Curve (shape)

(ii) 0.188 – 0.12 = 0.068 mol (I)
Therefore mass of hydrated copper (II) sulphate
= 0.68 x 250 = 17g

(b) (i) Moles of $AgNO_3$ = 0.1 x 24.1 = 2.41 x 10^{-3}

$$\frac{}{1000}$$

(ii) Moles of NaCI = Moles of $AgNO_3$
= 241 x 10^{-3}

(iii) Moles of NaCI in 250cm^3 = 2.41 x 10^{-3} x 250

25

$$2.41 \times 10^{-2}$$

(iv) R.F.M NaCI = 23 + 35. 5 = 58.5
Mass of NaCI in 5cm^3 = 2.41 x 10-2 x 58.5
= 1.41g

(v) Mass of water = 5.35 – 1.41
= 3.94g

(vi) 3.94 of water contains 1.41g of NaCI
100g of water = 1.41 x 100
3.94
=35.7

13. (a) (i) To get uniform mixing of the reagents hence uniform distribution of heat

(ii) $H^+(aq) + OH^-(aq)$ $H_2O(I)$ OR
$H_3O^+(aq) + OH^-(aq)$ $2H_2O(I)$

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Y_3 and Y_4 reaction has come to an end, the reaction mixture is cooling/loss of heat to environment

(iv) I.

$T=30.9 - 24.5 = 6.4^0C$

$H = 200 \times 6.4\ (I) \times 4.2 = 537$ joules

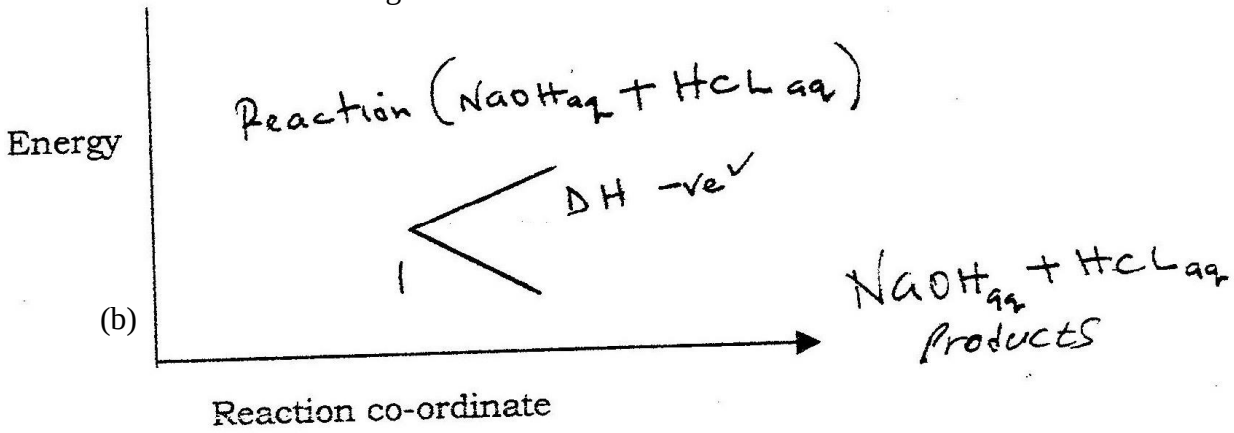
II. moles of NaOH = $\frac{100 \times 1}{1000} = 0.1$ moles

0.2 moles = 5376 joules therefore 1 mole = $\frac{5376}{0.1 \times 1000}$

$= 53.76$ Kj mol^{-1}

(v) Lower (I), ethanoic acid is partially ionized. Some energy is used to change the un ionized molecule into ions.

(b)



14. (a) (i) S and W

(ii) T,U,V

(b) (i) V(I) it is the only element whose boiling point is below 298K

(ii) V

(c) (i) $T(NO_3)_3$

(ii) $2S + U\ S_2U$

(d) Ionic (I) T. Is a metal while U is a non- metal (½). Therefore T loses electrons to U. T is electropositive while U electronegative. (½)

(e) (i) Cathode

Hydrogen (I)

(ii) Anode

Oxygen (I)

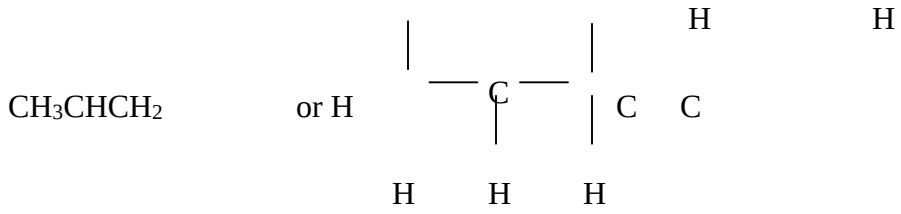
CHEMISTRY PAPER 233/1 K.C.S.E 2000
MARKING SCHEME

1. a) Mass increases because oxygen combine with copper metal
   b) Mass decreases it decomposes into gases that escape.
2. a) $2H^+ + 2e \longrightarrow H_{2\,(g)}$
   b) Mg (s)
3. a) Ammonia gas
   b) Filtration/precipitation/Crystallization
   c) $2NaHCO_3$ (s) Na_2 $Na_2CO_{3(s)} + CO_{2\,(g)} + H_2O_{\,(g)}$
4. a) q = It 1.5x15x60C
      = 1350c
   b) Alt. 1
      1350=0.6g of M
      3 x 96500
      = 0.26 x 3 x 96500
      1350
      = 55.76

      Alt 2
      M= Q x M
      0.26 = 1350 x M
      96500 x 3

      M= 0.26 x96500 x 3
      1350
      55.76
5. a) $T_{(s)} + X^{}_{2+\,(aq)} \longrightarrow T_{2+(aq)}\ X_{(s)}$
   b) SXTU
6. Add excess CU to HNO_{3+} filter the mixture, add excess soluble carbonate, filter to obtain residue. Or add CU to $H_2SO_{4\,+}$ and warm –(not a must), filter the mixture then add soluble carbonate, filter the residue. Or Heat CU in Oxygen to get CU, dissolve in an acid, filter add a soluble carbonate to soluble carbonate to the solution, filter to get the residue
7. It is light/less dense

   Its inert/noble/unreactive/rare gas/not flammable
8. Crystals of $KCLO_3$ come out because at 83^0C the solution is saturated with $KClO_3$. Cooling causes crystallization. All KNO_3 OR $KClO_3$ forms solid (40-9) 31g. KNO_3 do not form solid
9. a)



   b) Propane or prop – 1 – ene

10. a) H Ca CO_3/ calcium carbonate / limestone/manila chips J CaO/Calcium oxide/quick lime

b) As a fertilizer/for liming living furnaces / raising soil pH/ Manufacture of CaC_2/$Ca(HSO3)_2$ /$Ca(OH)_2$/Absolute alcohol.

11. Alt 1

Molarity of NaOH = 4 = 0.1M

Moles of NaOH = $\frac{20 \times 0.1}{1000}$ = 0.002

moles of H2SO4 = 0.001

8cm3 = 0.001

1000cm3=?

= 0.1235M

Alt. 2

H2SO4(aq) + 2NaOH(aq) Na2SO4(aq) +H2O(l) ⟶

Molarity of NaOH = $\frac{4}{40}$ = 0.1M

$\frac{MaVa}{mbVb} = \frac{1 \text{ ma } x8}{2 \ 0.1 \ x20} = \frac{1}{2}$

Ma = $\frac{0.1x20}{8 \text{ x2}}$

= 0.125M

12.

13.

14. a) Cation Al_3 or Mg^{2+}

Anion SO42-

b) $Ba^{2+}_{(aq)} + SO4^{2-}_{(aq)} \longrightarrow BaSO_{4(S)}$

15.

Luminous	Non – Luminous
- Its sooty or Smokey	- Not sooty or Smokey
- Not very hot	- Steady
- Not steady	- Noisy
- Quit	

Any two in order / No other differences.

16. When dissolves in water or fused / molten state

17. a) Mg(s) + H2O(g) MgO(s) + H2(g) Mg(s) + 2H2O(l) Mg(OH)2(s) + H2(g)

b) Insoluble in water / slight soluble

Mention of water is not necessary since the liquid is not labeled.

18. tO3 = $\frac{V}{96}$ R.M.M. = 48 tCO2 = $\frac{V}{t}$ R.M.M =44

$\frac{V}{96} \div \frac{V}{t} = \frac{\sqrt{48}}{\sqrt{44}}$ $t = 48$

$96 = 44$

$t = 96 \times \frac{\sqrt{48}}{\sqrt{44}} = 91.9$ or $= 92\text{sec}\ (^1/_2)$

19. I – Manganese (iv) Oxide is a catalyst and increases the rate of decomposition of the hydrogen peroxide.

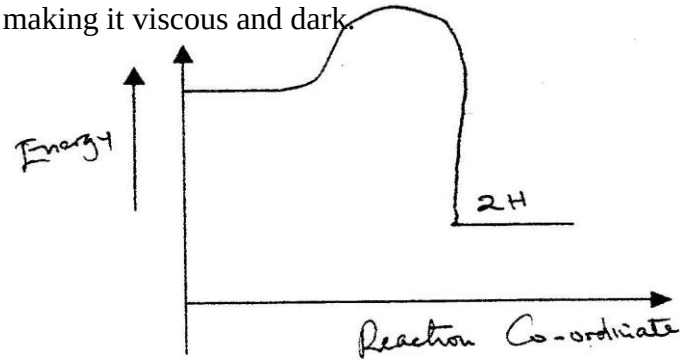
20. Add water to the mixture in a separating funnel. Ethanol dissolves while pentane does not. Allow the mixture to separate in two layers. Open the tap to drain the lower aqueous layer. Distil the water ethanol mixture to get ethanol.

21. Acet5ylene (ethyne) or Hydrogen

22. a) C b) A

c) B

23. Solid sulphur is made of S8 rings. It melts into aliquid of S8 rings, On further heating the rings open up to form long chains of sulphur atoms, which then entangle making it viscous and dark, or sulphur melts into S8 molecules. The molecules join up to form long chain which entangle making it viscous and dark.



25. The supply of oxygen in the room will be limited leading to formation of CO which is
24.a)

poisonous.

26. NH4Cl decomposes to form NH3(g) and HCl(g).Ammonia diffuses faster than HCl because its light. Ammonia is basic and thus red litmus paper turns blue while HCl is acid thus blue litmus turns red.

27. It reacts with NaHCO3 to form CO2 which causes the dough to rise.

CHEMISTRY PAPER 232 /2 K.C.S.E 2000 MARKING SCHEME.

1. a) i) Alkaline earth metals

ii) A

iii) Covalent

They form bond by sharing of electrons:

iv) D_2O_3 or Al_2O_3

v) Tick or G is in the right place

b) i) H

Their boiling points are quite close

ii) K

iii) I L its boiling point is lower than room temperature and is slightly soluble in water.

II J

2 a) i) I Distilled water / H2O

II Titanium / platinum

ii) Chlorine / Cl2(g)

iii) L - paper industry / Rayon manufacture/ Dyes manufacture

-Glass industry

- Manufacture o soaps / detergents
- Manufacture of al from its ores.
- Manufacture of bleaching agents
- Manufacture of drugs / anit acid drugs.

(Any one use = 1mk)

II - To reduce running costs / make process economical

- To avoid pollution

b) i) I. 2NaHg + 2h2O(l) 2NaOH(aq)+2Hg + H2(l) or 2 Na/hg + 2H2O(l) 2NaqOH + Hg + h2(g)

ii) Q = It = 100x5x60x60 = 1800000C 1 Faraday forms 1 mole of Na

1 mole of NA /Hg = 1 mole of NaOh NaOH = 23 + 16+ 1= 40 96,500 40g of NaOH.

1800000C 40 x 1800000

96500

=746.1g

3. a) i) - Galena (reject pbS on its own)

ii) - Some of the sulphide is converted into oxide.(pbO orSo_2

iii) - Carbon monoxide (CO) or carbon dioxide (CO_2)

i) - $pbO_{(l)} + C_{(s)}$ pb + $CO_{(g)}$

v) - To reduce unreacted pbS to pb vi) - So2 cause acid rain 3. Lead is poisonous / a pollutant

(any two @ 1mk = 2mks

b) -Hard water contains Mg+2 /Ca+2

- These ions form a protective layers of CaCo3/ CaSO4 Mg C)3 on the lead
- Soft water does not form these deposits

c) Radiactive shielding

Lead accumulators / batteries

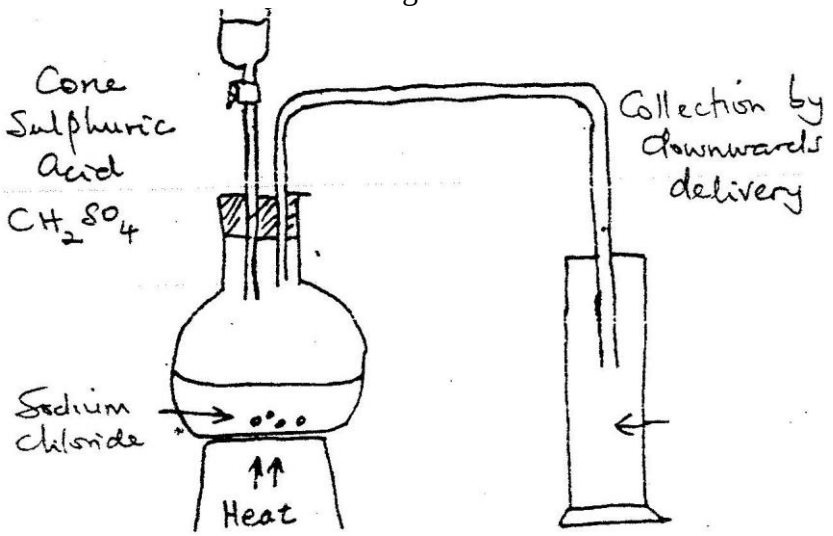
Making roofs

Making Alloys e.g. soldering wire

Manufacture of anti – knock additives Manufacture of paints

Manufacture of ball bearings.

4. a i)



ii) $NaCl_{(S)} + H_2SO_{4(l)}\ NaHSO_{4(s)} + HCL_{(g)}$

iii) - Concentrate sulphuric acid

- Silica gel
- Anhydrous CaCl2 (anyone = 1mk)

iv) A white precipitate of $pbCl_2$ is produced.HCl gas in water ionizes to form H+ ions and Cl ions; the Cl- ions combine with pb+2 to form Lead (II) Chloride.$pbCl_{2(s)}$

$HCl_{(aq)} \longrightarrow H^+ + Cl_{(aq)}$

$Pb + 2Cl^-_{(aq)} \longrightarrow PbCl_2(s)$ (White ppt)

v) HCL is not oxidizing agent it only reacts and removes the oxides hence cleaning the surface.HNO3 is a strong oxiding agent; it re – oxidizes the cleaned surface.

B (i) $HCl_{(aq)} + NaOH_{(aq)}\ NaCl_{(aq)} + H2O_{(l)}$

Moles of NaOH = Moles of HCL

$= \frac{46x11}{1000} = 0.506$ moles

(ii) Moles of HCL in $250cm^3 = 0.506 \times 10 = 5.06$

R. M. M of HCL= 1 +35.5 = 36.5

Mass of HCL = 5.06 x36.5

= 184.69

Q = 14

5. (a) (i) Pent -2 –ene

(ii) Butanoic acid

(b) (i) substitution

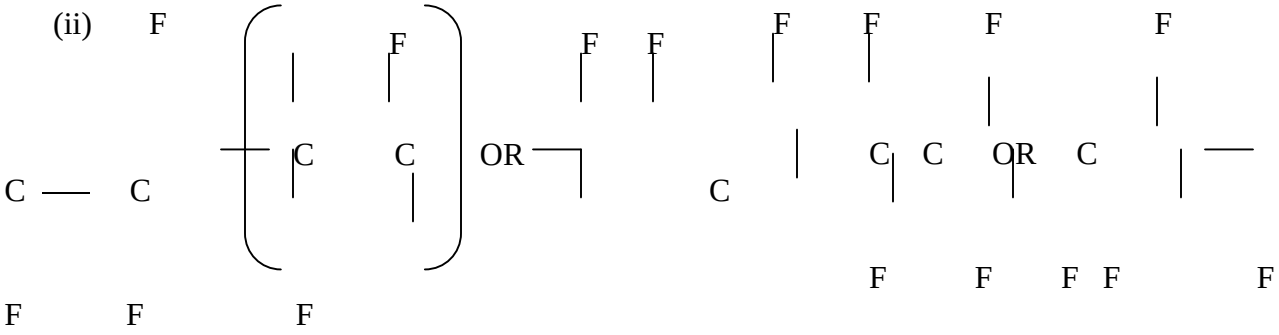
(ii) Addition

(c) (i) $2C_4H_{10(g)} + 13O_2(g) \longrightarrow 8CO_{2(g)} + 10H_{2(l)}$

(ii) Carbon dioxide (CO_2) is produced. This then dissolves in water, forming forming an acid solution.

(d) (i) Process where monomers (small molecules) form together to form large molecules (polymers)

(ii)



(e) -Cheaper -More durable - Can be recycled

-Can be made on demand -Easy available

-Easily moulded/made into many shapes

-Not attacked by acids or alkalis

-corrosion resistant

6. (a) (i) M. Graphite

N diamond

(ii) 1. Tips of drills/drilling devices 2. Jewellery
3. Glass cutters/Cutting glass
4. Making bearings
5. Padlocks 6. Ornaments

(iii) M/Graphite: The fourth electron of each carbon is unbounded/free /delocalized

(b) (i) $C_{(g)} + Co_2(g)\ 2CO_{(g)}$

(ii) Potassium hydroxide (KOH) or Calcium hydroxide Ca (OH)2(g)

(iii) Pass the gas through limewater ($ca(OH)_2(aq)$; CO_2 forms a white precipitate but CO does not give a change or CO burns with blue frame while CO_2 does not burn

(iv) -Fuel in water gas and produces gas/synthetic petrol

-Extraction of metals

-Manufacture of methanol

7. (a) (i) Add a drop of the liquid to anhydrous/white copper(II) sulphate ($CUSO_4$) and it will turn blue. Or use cobalt chloride paper; which turns from blue to pink (an hydrous cobalt chloride)

(ii) -find the boiling point; water has a b.p of 100^0 C at 1 atom pressure. (iii) -Find the freezing point; water has a freezing point of ^{0}C at 1 atom pressure.

-Find density; water has a density; water has a density of 1g/cm at 4^0C

(b) (i) large solid particles/ pieces of rock/ sand /to condense/settle

(ii) sedimentation rej. Precipitation

(iii) I Causes the small suspended particles to condense/setylr

II Kill microorganisms/microbes/germs

(c) (i) permanent

(ii) -Addition of $Na_2CO_{3(aq)}$ which precipitate Mg +2 as $MgCO_3$ or

-Use of distilled residue of $MgSO_4$ is left behind or

-Use of ion exchange resing which will remove mg^{+2}

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MARKING SCHEME

1. (a) Atoms of the same element that differ in mass numbers, same number of protons but different number of neutrons

(b) $^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$ or $^{14}_{6}C - {}^{14}_{7}N \rightarrow {}^{0}_{i}e$

(c) Carbon dating ‖Isotope tracers ‖tracing of biological processes

2. Experiment II. At a high temperature the particles have more energy, hence rate of high energy collisions increase.

3. (a) (i) B ‖Magnesium ‖2.8.2

(ii) C ‖Sodium ‖2.8.1

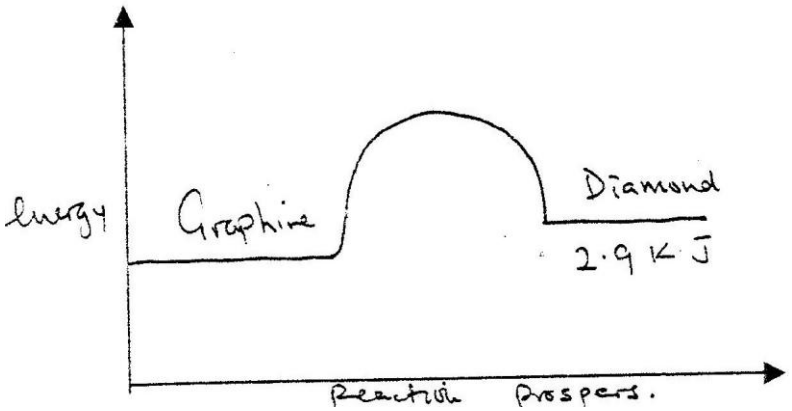
(b) D‖ Argon ‖2.8.8.2

4. (a) Any suitable ammonium salt $(NH4)_2\ SO_4\ NH_4CI$ e.t.c

(b) $Al^{3+}(aq) + 3OH^-(aq) \rightarrow Al(OH)_3(s)$

5. To keep away air/ oxygen which would react with it

6.



7. Heat the mixture iodine sublimes and can be collected from the cool part of the test tube.

8. (a) Effervescence due to production of carbon dioxide ‖Hissing ‖fizzing ‖bubble
(b) No change observable. Copper is below hydrogen in the activity series therefore cannot displace hydrogen

9. (a) Potassium chloride ‖KCI (b) Calcium chloride ‖$caCI_2$
(c) Lead (II) nitrate ‖$Pb(NO_3)_2$

10. R.m.m of $H_2O = 2 + 16 = 18$
R.m.m of $Na_2CO_3 = 46 + 12 + 48 = 106$
Moles $H_2O = \frac{14.5}{18} = 0.805$
Moles of $Na_2CO_3 = \frac{85.5}{100} = 0.866$
Mole ration $Na_2CO_3:H_2O$
1: 1

$16 + 18 = 100\%$
$\frac{18n}{106 + 18n} = \frac{14.5}{100}$
$18n \times (-100) = 14.5(106 + 18n)$
$1800n = 1537 + 261n$
$1539n = 1537$
$1537 = 09987$
1539

11. SO_2 which is poisonous is released in the air. Acid rain which may cause corrosion will be formed
12. Add dilute acid (e.g. HCI or H_2SO_4) to each substances separately. If Na_2S, colourless gas, smell of rotten eggs
13. G3, because it has the smallest atomic radius. Its outer most electron is tightly held by the nucleus or it requires a lot of energy to remove it.
14. (a) Electrolysis of fused or molten oxide
(b) JCH ‖J, carbon, H

15. (a) Hygroscopy
(b) Drying of gases ‖drying agent

16. Magnesium is above iron in the activity series. It supplies electrons to the iron bar Hence prevent it from rusting

17 (a) Presence of Ca (HCO_3) or mg $(HCO_3)_2$
(b) Water vaporizes and distils off leaving behind ions that cause hardness

18 (a) The idea of being replaced by a halogen ‖reaction where one hydrogen atom of an alkane is replaced.

(b) H H

H H

I	I		
C	C	Cl	or. CH_3CH_2Cl Chloroethane ‖Ethylchloride
I	I		
H	H		

19. The burning magnesium produces more heat energy that the burning splint. The heat energy from magnesium is enough to break the sulphur oxygen bond setting free oxygen magnesium uses freed oxygen to continue burning.

20. (a) A black solid formed

(b) $Zn(NO_3)_2(aq) + H_2S(g) \rightarrow ZnS + 2HNO_3(aq)$

Or $Zn^{2+}(aq) + S^{2-}(g) \rightarrow ZnS(s)$

Or $Zn^{2+}(aq) + HS(g) \rightarrow ZnS(s) + H^{+}(aq)$

21. (a) Reddish brown // Brown solid formed

(b) $CuO_{(s)} + CO(g) \rightarrow Cu(s) + CO_2(g)$

(c) it is poisonus // harmful // dangerous// toxic // pollutant

22. It has one electron in its outermost energy level, which it can loose to form H^{+} showing oxidation sate of $^{+1}$ or gain an electron to form H^{-} showing and oxidation state^{-1}

23. (a) Copper metal M

(b) Magnesium chloride K

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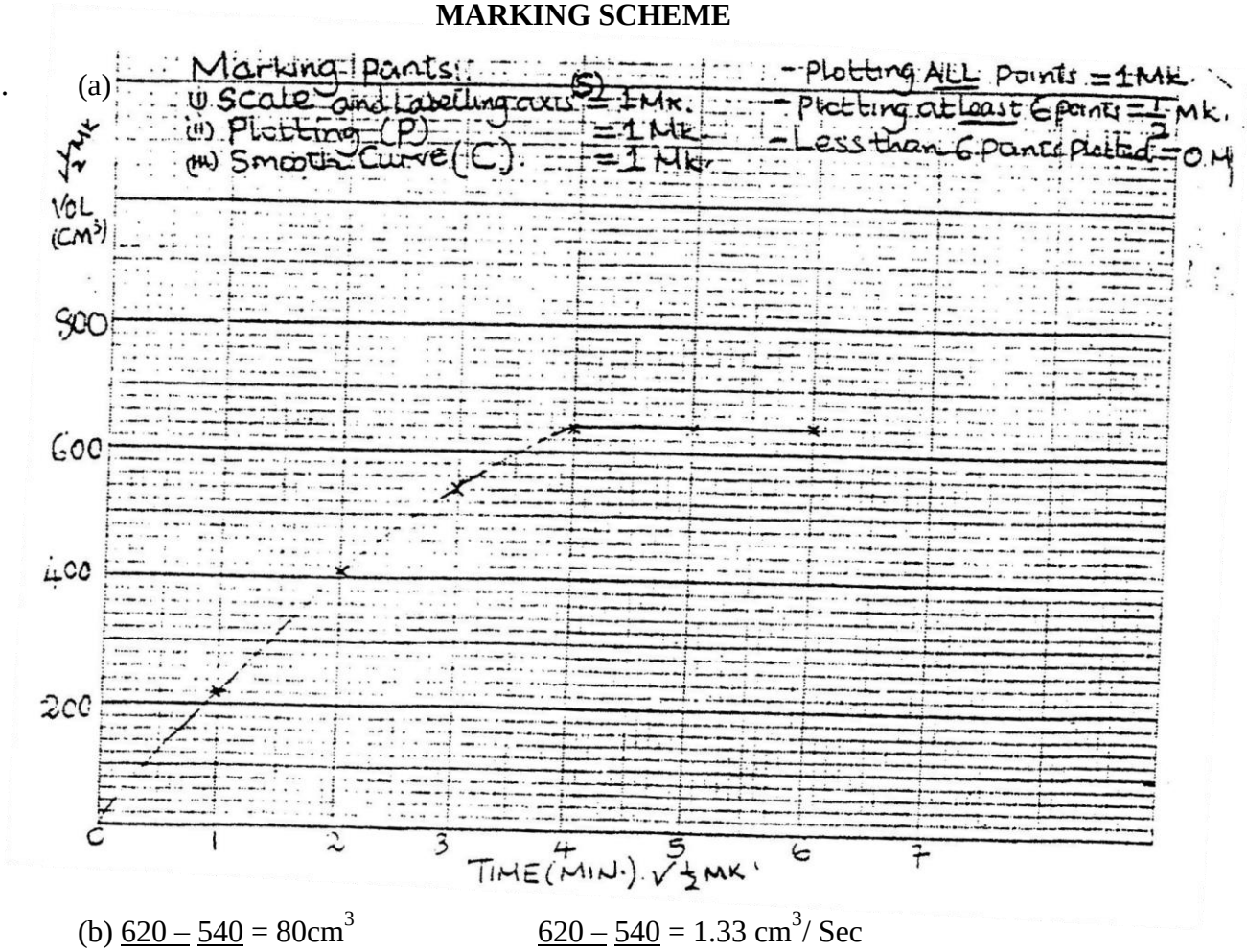
MARKING SCHEME

1. (a)



(b) $\frac{620 - 540}{1} = 80 cm^3$ $\frac{620 - 540}{60} = 1.33\ cm^3/\ Sec$

(c) Solid is due to presence of copper which had NOT reacted (1 mk) as it is below hydrogen in the activity series (1 mk) Don't accept does not displace hydrogen from the acid. (Candidate should state the reason why copper does not displace hydrogen).

(d) Vol of $H_2O = 640 - 2.5\ cm^3$ - Mass of Al = $\frac{637.5}{24000} \times \frac{2}{3} \times 27$

$= \frac{637.5\ cm^3}{24000}$ $= 0.47g$

- Moles of $H_2 = 637.5\ cm^3$
- Mole ration of AL: H2 = 2:3
- Moles of AL(s) = $637.5 \times \frac{2}{24000}$ 1 mk
- % Mass of AL = $\frac{0.478}{0.5} \times \frac{100}{2}$ (Range 95.55 – 95.64%) 3

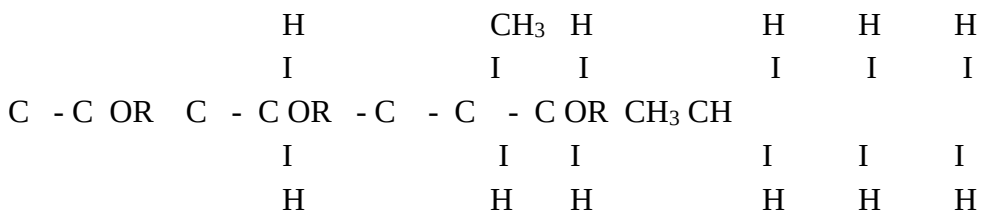
(e) - It is stronger than pure aluminium (1 mk)
- It is harder than aluminium (1 mk)
- It is not easily corroded/ rusting (1 mk)
- It is more durable / higher ensile strength (1 mk)
(-Any correct two = 2 mks)

2. (a) (i) Alkyline
(ii) Carboxylic acid or Alkanoic acid
(b) (i) Vulcanisation
(ii) - To harden rubber
- To make it tougher/ stronger
- To make it durable
- To last longer
(any answer cancels the correct)

(c) (i) $2CH_3CH_2CH_2OH(l) + 2K(l) \rightarrow 2CH_3CH_2CH_2OK(s) + H_2(g)$
(State symbols not necessary in equations involving organic)
(ii) I Dehydration
II Hydrogenation
(iii) A 1,2 – dibromopropane or formula, $CH_2Br – CHBrC$ + $\frac{1}{3}$
B Ethene or formula C_4H_4

(iv) Nickel/ Palladium/ Platinum

(v)



(d) - Production of hydrogen
- Production of carbon tetrachloric
- Production of acetylene or ethane
- Production of carbon black used for making printers ink
- Preparation of methanol

- Preparation of chloroform

3. (a) (i) - G2 OR G (do not accept G^-)

- It has highest positive electrode potential (1 mk) or it has the highest reduction potential (1 mk)

(ii) -G and N or (1mk)

+ 1.36 and -2.92 or (1mk)

Cell (i) and (iv) (1 mk)

(iii) $2N^+(aq) + M(s) \rightarrow 2N(s) + M^{2+}(aq)$

- it cannot take place (1 mk) misbelow N in activity series (1mk) and cannot displace N from its solution (1 mk) Or - It cannot take place from left to right.

E Cell = 2.92 + 0.44 = -2.48

E value is negative (1mk) reaction cannot take place spontaneously.

(e) (i) $4OH(aq) \rightarrow 2(g) + 2H_2O(l) + 4e^-$

(1 mk for state symbols missing Eq'n not balanced = 0 mk; joining the chemicals symbols in an equation = 0 mk)

(ii) Insert a burning splint in a gas K. (1mk) the gas should burn with a pop sound to show it is hydrogen (½ mk) (observation and the lest are tied together) (½ mk)

(iii) I. Hydrogen is monovalent (1 mk) and oxygen is divalent or (½ mk)

$4OH^-(aq) \rightarrow 2H_2O + O_2(g) + 4e^-; 2H^+(aq) + 2e \rightarrow H_2(g)$ (½ mk)

The vol of $H_2(g)$ is twice O_2 because to produce 1 mole of $H_2(g)$2 moles of electrons required and produce 1 mole of $O_2(g)$ -4moles of electrons are given out.

II. The bulb is brighter with sulphuric acid. Sulphuric is a strong acid hence its degree of ionization is higher sulphuric acid is a strong acid, ethanoic acid is a weak acid

(accept words dim, dimmer, less brighter or w.t.t.e)

4. (a) (i) KOH or NaOH or chemical names or common nodes

(any contradiction = 0 mk)

(ii) (Boiling points Nitrogen = -196^0 C, Oxygen = -183^0C)

- Heat/ boil the liquid air/warm/ raise the temp of liquid air

- Nitrogen comes out first because it has a lower boiling point than oxygen

(if word heating/ boiling/ raising the temp or warming not mentioned the candidate score 0mk)

(b) (i) Hydrogen or H_2

(ii) - So that all ammonia gas can be converted to Q or NO(g) (1mk) or

- To increase the yield of gas Q or NO (g) (1 mk) OR
- For complete oxidation of ammonia or reduce the cost of Production

(iii) - NO(g) or nitrogen monoxide or nitrogen (II) oxide (1mk)

(iv) $NH_3(g) + HNO_3(aq) \rightarrow NH_4NO_3$ (aq)

(½ mk for state symbols; Equation not balanced or chemical symbol joining or use of capital letters for small letter or vice versa in chemical symbols = 0 mk)

(i) - Fertilizer (don't accept manufacture of fertilizers)

- Explosives

(wrong use cancels the correct use therefore = 0mk)

(c) - Brown gas formed (½ mk) and sulphuric or disappears - The brown gas is NO_2, HNO_3 acid reduced by sulphur - Sulphur is oxidized to SO_2, or H_2SO_4 or H_2SO_3acid.

5. (a) Potassium permanganate, Manganese (IV) oxide, Lead (IV) oxide

KM_nO_4 or MnO_2 or PbO_2

(b) I. to remove all oxygen or air which would form iron (III) oxide

II. CaO absorbs both $Cl_2(g)$ and moisture. $CaCl_2$ can only absorb Moisture

(c) It sublimes or changes directly from solid to gas

(d) $CaO(s) + H_2O(g) \rightarrow Ca(OH0_2$ or

$CaO(s) + Cl_2(g) \rightarrow CaOCl+2(s)$ or

$Ca(OH) + Cl(g) \rightarrow CaOCl_2H_2O$

(e) (Fe = 56.0,Cl = 35.5 and molar gas volume at 298K is 24,000cm^3)

$2fe(s) + 3Cl_2(g)$ $2FeCl_3(s)$ or mole ratio 2:3

- R.F.M of Fe = $\frac{0.5}{162.5} = 0.003$
- Moles of $Cl_2 = \frac{3}{2} \times 0.003 = 0.0045$

Vol of gas = 0.0045 x 24000

= 110.76cm^3 – 111cm^3

Alternative method

$2Fe(s) + 3Cl_2(g)$ $2FeCl_3(s)$

3 x 24000 x 05 = 3

162.5 x 2

= 110.76cm^3 >111cm^3

(f) - Fe^{3+}(aq) is reduced to Fe^{2+}(aq) or Fe^{2+} (aq) ions formed

- H_2S(g) is oxidized to sulphur or sulphur is formed
- (contradiction of the process subtract (½ mk)

(g) - Turns red thin white/ decolourised/ bleached. ½ mk

- Chlorine is acid and also a bleaching agent or
- Litmus paper is bleached
- Chlorine is a bleaching agent

Equation:Cl_2(g) + H_2O(l) →HOCl(aq) + HCl (aq); then HOCl(aq) + Dye →Dye (o) + HCl

6. (a) (i) Alkali metals

(ii) - Enthalpy change when 1 mole of e-5 is removed from 1 mole of gases atom or

- Energy required to remove radius therefore the outermost electron is MOST STRONGLY attracted to the nucleus, hence more energy is required to removed it.

(most strongly or very strongly in the attraction must be mentioned for a candidate to score 1 mk)

(b) - Melts because of the heat produced or reaction is exothermic

- Hissing sound due to the production of H1 gas during reaction
- Moves on the surface due to its being propelled by the hydrogen gas

(c) 2q (s) + $2H_2O$(L) → 2QOH (aq) + H_2 (g)

2Na(s) + $2H_2O$(l)→2NaOH(aq) + H_2(g)

(d) - A strong base produced a high concentration of OH e.g. NaOH, KOH, Na_2O or K_2O, woodash, Li_2O or LiOH

- A weak base products a low concentration of OH^- ions e.g. NH_3(g), $Ca(OH)_2$ Ca), $Mg(OH)_2$ or MgO or

- Strong base has more OH^- ions or PH of 12 - 14
- Weak bas has few OH^- ions or PH of 8-*11*

(e) (i) – Reaction between 1 mole of H+ and 1 mole of OH- to form 1 mole of H_2O

- H^+ (aq) + OH^- (aq) H_2O(l)
- Reaction between an acid and base to form a salt and water only

(ii) – Add 200cm^3 of 2M HNO_3 to the 200cm^3 of 2 M NaOH

- Allow the mixture to cool for crystals to appear
- Filter/ decant to obtain crystals or
- Filtrate with a suitable indicator. Get the end point

Repeat without an indicator. Then follow the other step.

NB: candidate must mention 200cm^3 or 2MHNO for other steps to be correct

(iii) $2NaNo_3(s)$ $2NaNo_2(s) + O_2(g)$

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MARKING SCHEME

1. It is uncreative
2. Oxygen exists as discrete molecules (O_2) with only weak van der wall forces between them. While sulphur exists as S_8 rings and chains which are bulky
3. A sulphur, carbon, nitrogen

   B Sodium potassium, lithium
4. (a) The hypochlorous acid decomposes to form (atomic oxygen)

   The atomic oxygen attacks and bleaches the blue flower

   (b) $2HOCl(aq) \rightarrow O_2(g) + 2HCl(aq)$
5. (a) calcium 2.8.8.2 Beryllium 2.2

   (b) Both elements are in the same group but the two valence electrons of calcium are further away (1) They are not strongly held by the nucleus, hence are readily released.

   (1) (3 mks)
6. (a) Oxygen (1)

   (b) Decomposition (1) (2 mks)
7. Use zinc powder (1), which has a larger surface area (1) (2mks)
8. (a) C_2 = Fes, Zns (1)

   (b) It is soluble in cold water (1)

   (c) it turns black (1)
9. (a) Displacement (1) (b) DGEF (1)

   (c) $G(s) + 2F^+(aq)$
10. (a) Alpha or He (10)

    (b) 210 210

    J k e

    81 → 82 + -1

    (c) K and M
11. SO reacts with water to form $SO^{2-}{}_3$/ sulphurous acid (10 which then is oxidized by chlorine to $S)^{2-}{}_4$/sulphur acid (1). $SO^{2-}{}_4$ reacts with Ba^{2+} to form insoluble $BaSO_4(l)$
12. Concentrated nitric acid is a strong oxidizing agent (½). It oxidizes pale iron (II) (½) to yellow iron (III) (½) and it is reduced to nitrogen dioxide (1) which is brown (½)

3 mks

13. (a) Lattice energy (a)

(b) Let the heat be H_3

H_{3-} - 701 = 15 (l)

H_3 = 686 kJ mol -1 (2mks)

14. (a) Fe_2O_3, Fe_3O_4 (l)

(b) $CaO(s) + SiO_2(s) \rightarrow CaSiO_3(s)$ (l)

15. (a) $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCo_3(s) + H_2O(l)$

(b) White PPt dissolves (l) because the insoluble $CaCO_3$(½) is changed into soluble calcium hydrogen carbonate. (½)

16. Covalent bonds exist between two iodine atoms(½) in an iodine molecule (1 white Van der waals forces exists between two or more molecules of iodine (1) covalent bonds are strong than Van der walls forces

17. a) Perspex(10

b)As a substitute for glass in the manufacture of

- safety screens
- plastic lenses
- Wind screen Accept any other correct use.

18. Add excess zinc oxide (½) to dilute HCL, HCl, H2SO4, HNO3 (½) Filter to the filtrate, add aqueous Na2CO3 K2CO3(½) to precipitate znCO3(½)filter (½)

20. I Conducts (1)

II Ionic (I)

III Covalent (i)

21. a) 2Na OH(aq) + H2SO4(aq) Na2SO4(aq) +H2O(l) (l) (3 marks)

b) Blue litmus paper turn
remains red

c) The acid was in excess (l)

22. a) Manganese (IV) oxide (1)

b) -Welding (l)

- Fuel in rockets
- Breathing aid / hospitals
- Steel making (3mrks)

Accept any other correct ans

23 $Pb(X O_3(aq) + 2NaCl(aq) + 2NaNO_3(aq)(l)$

R.F.M NaCl = 58.5

R.F.M PBCl2 = 278(½)

Moles of pbCl2 = $\frac{2.56}{278}$

Moles of NaCL = 2.56 x2 (½)

= 278

Mass of NaCl = 0.04 x 58.5

= 2.34g

24. a) Being acidic, it would react with the basic ammonia(l) (2mks)

b) CaO (i)

25 a) Butane (l)

b) Hardening of oils in the (a) manufacture of margarine (2 marks)

26. a) $Ag^+(aq) + e \rightarrow Ag(s)$ (l) b) Anode decreases in size/mass

It dissolves/ions to release elections (l)

(3marks)

27. a) pb^{2+} or Ag+ Hg2+ Absent(i)

b) Zn^{2+} (l)

c) $Zn^{2+}(aq) + CO_3^{2-}(aq) \rightarrow ZnCO_3(s)$(l) (3 mks)

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MARKING SCHEME

1. (a) Distillation/ Fractional distillation

(b) (i) Add water to the mixture; sodium chloride being an ionic compound dissolves. Filter the mixture to remove sulphur as a residue. Sulphur being a molecule substitute does not dissolve. Evaporate the filtrate to obtain sodium chloride.

(ii) Determine the melting point, If it sharp then it is pure. Narrow range/ fixed/113^0C/Content/ Definite.

(c) (i) potassium bromide/ KBr

(ii) 60 – 55 = 5g

(iii) Fractional crystallization

(iv) Extraction of salts/Na_2CO_3/Solvay process

Production of salts

Solving process

2. (a) (i) Sodium hydroxide (1 mk)

(ii) ethne/C_2H_2 //H – C = C-H (1 mk)

(b) Polymerization // Addition polymerization (1mk)

(c) - making artificial leather/ rain coats/ manufacture of cromophone

- making plastic water pipes

- Making electrical insulators (1 mk)

(d) $2Cl^-(aq) \rightarrow Cl_2(g) + 2e$

$2Cl(aq) - 2e \rightarrow bCl_2(g)$

(e) Deep brown solution // dark black brown solid is formed. Chlorine is more reactive than iodine, it displaces if formed.

(f) (i) $2NaOH(aq) + Cl_2(aq) \rightarrow NaCl(aq) + NaOCl(aq) + NaOCl(aq) + H_2O(l)$//
$2OH^-(aq) + Cl_2(aq) \rightarrow OCl^-(aq) + Cl^-(aq) + H_2O(l)$

(ii) Moles $\frac{2 \times 15000}{1000} = 30$ or $2 \times 15 = 30$

R.F.M NaOCl = 23 + 16 + 35.5 = 74.5

Molar mass = 3 + 16 + 35.5 = 74.5

Moles of NaOCl $= 30 \times \frac{1}{2} = 15$

Mass of NaOCl $= \frac{15 \times 74.5}{1000} = 1.1175$

Mass in kilograms of the sodium hypochlorite produced = 1.1175

3. (a) Exothermic reaction – heat energy given out to surrounding

Endothermic reaction – heat energy is absorbed from the surround

(b) (i) Vaporization// melting// evaporation// boiling

(ii) Condensation // freezing

Sublimation must be given with the solid that sublimes

(c) The water is undergoing a change of state. The heat supplied is used in breaking the inter particle forces between molecules of water OR intermolecular bonds

(d) (i) Heat of formation of $FeCl_2$

(ii) $\Delta H_1 + \Delta H_2$ OR $\Delta H_1 = \Delta H_3 - \Delta H_2$ OR $\Delta H_2 = \Delta H_3 - \Delta H_1$

(e) Butane because more bonds are formed on combustion of butane hence more heat released OR Butane has a large molecular mass / carbon atoms OR Butane has highest percentage of carbons.

4. (a) E; its ions have the greatest tendency (+ 0.85Y) to accept electrons// has reduction potential // strongest oxidizing agent

(b) (i)

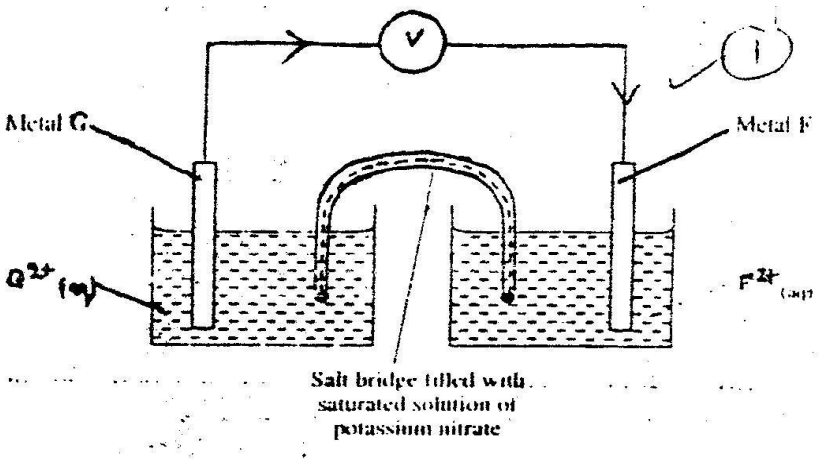
F

$F^{2+}(aq) + 2e \rightarrow F(s)$

G

$G(s) \rightarrow G^{2+}(aq) + 2e$

(ii)



(iii) To complete the circuit // maintain charge balance // Enable ions to move to cell too

(c) (i) The blue green colour of the solution fades; Cu^{2+} are removed from the Solution

(ii) The two gases are chloride and oxygen; initially Cl^- are at a more higher Concentration of Cl^- goes hence the OH^- is discharged reading to production of oxygen gas

$2Cl^-(aq) \rightarrow Cl_2(s) + 2e$

$4\ CH^-(aq) \rightarrow 2\ H_2O_{(4)} + O_2(g) + 2$ //e

(iii) J; Negativity charged ions (aq – and not OH – can only move to the anode // anode is the charged hence attract Cl^- and HO

5. (a) (i) Hydrogen // H

(ii) carbon //C

(b) (i) Extinguishes // put off // goes off // want out // Die; CO_2 and Water vapour, which do not support combustion, accumulates around the supply of oxygen

(ii) Mass increases; water vapour reacts with CaO and forms Ca (OH)

$Ca(OH)_2$ reacts with Co_2 to produce $CaCO_3$

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s) \rightarrow$ CaO reacts with moist CO_2

$Ca(OH)_2 + CO_2(g) \rightarrow CaCO_3(s) + H_2O$

(iii) Oxygen and Nitrogen Helium, Neon argon; Accept a name of inert gas

(iv) To absorb excess water vapour // moisture

(v) Sodalime // $NaOH^-$ and CaO // KOOH // Caustic potash // caustic soda

6. (a) Milachile // Copper pyrites // Chalcasite // Chalcopyrite // Bonile // a zurile

(b) (i) Hydrogensulphide // H_2S

Reagent Q (1 mk)

Sodium Carbonate // $NaCO_3$ // $NaHCO_3$ // Potassium carbonate //

Solid R

Copper (ll) Oxide // CuO

(ii) $CuCO_3(s) \rightarrow CuO(s) + CO_2$

Step 4

- Green solid dissolves to form blue solution
- There is effervescence // bubbles

Step 7

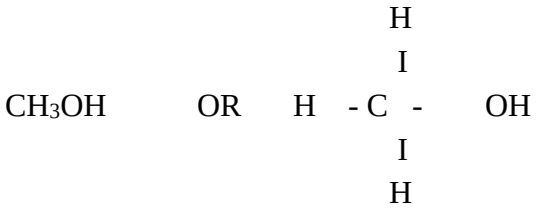
- Black solid dissolves to form a blue solution

(c) (i) Tin // Sn

(ii) Ornaments // medals // metal bearings in machines // jewels // spear head // making coins // gear wheels // rims of car // clocks springs // electric contact.

7. (a) Write the structural formula of:

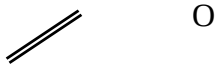
(i) Methanol (1 mk)



CH_3OH OR H - C - OH

H

(ii) Methanoic acid (1 mk)



O

HCOOH OR H - C - OH

(b) Write the equation for the reaction between methanoic acid and aqueous sodium hydroxide (1 mk)

$NaOH(aq) + HCOOH(aq) \rightarrow HCOONa(aq) + H_2O(aq)$

(c) (i) Name the product formed when methanol reacts with methanoic acid

Methylmethanoate // $HCOOCH_3$ // H – C – O – CH_3

(ii) State one condition necessary for the reaction in © (i) above to take Place

- add conc. H_2SO_4
- Heat to 180^0C // warm // heat

(d) (i) Describe one chemical test that can be used to distinguish between hexane and hexane

- Use a bromine water // acidified potassium permanganate
- If hexane they will be decoloured
- If hexane no decolourisation

(ii) State one use of hexane

Fuel // solvent // manufacture hexanol // hexanoic acid, hexanol (iii)
Hydrogen gas reacts with hexane form hexane. Calculate the volume or hydrogen gas required to convert 42g of hexane to hexane at S.T.P (C = 12.0, H = 1.0, Molar gas volume at S.T.P is = 22.4 litres). (4 mks)

$C_6H_{12} + H_2 = C_6 H_{14}$ mole ratio = 1:1 R.MM
of hexane = 42/84 = 0.5

Moles of hydrogen = 0.5

Volume of hydrogen = 0.5 x 22.4 = 11.2 litres of 11 dm^3

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MARKING SCHEME

1. Add water to the mixture (1) Sodium chloride dissolves(1/2) while Copper (II) oxide does not (1/2) filter (1/2) and heat the filtrate to dryness to obtain Sodium chloride(1/2).

2. K+ has three energy levels while Na+ has only two (1)
Mg2+ nucleus has 12 protons attracting 10 e-(1) Na+ has 11 protons attracting 10e- hence Mg2+ radius shrinks more (1) Or Mg2+ has higher nucleous charge (1) shrinking the ions(1)

3. $2Al_{(s)} + Fe_2O_3 \longrightarrow Al_2O_3 + Fe_2$, $3/2\ O_2$ $H = -1673.6\ Kjmol^{-1}$(i)
$O_{3(s)} \longrightarrow 2Fe + 3/2\ O_2$, $H = 836.8KJ\ mol^{-}$

4. a) Rhombic Octahedral Or Monoclinic – B – Prismatic

b) - Vulcanisation
- Manufacture of sulphuric acid / So2
- Gun powder
- Preparation of Ca(HSO3)2
- Drugs
- Fungicides
- Match sticks head

5. $H \longrightarrow H^+ + e$ ($^1/_2$) H is +ve ($^1/_2$)
$H^- \longrightarrow H + e$ ($^1/_2$) H is –ve ($^1/_2$)

6. $Na_2SO_3(s) + 2\ HCl\ (aq) \longrightarrow 2NaCl\ (aq) + SO_2\ (g) + H_2O(l)$
Moles of So2 = 160 / 2400 =0.04
Mass of NaSO3 0.04 x 126 =5.04 gm
Moles ratio 1:1
Moles of NaSo3 = 0.04

7. HCl is a strong acid hence fully ionizes.Ethanoic acid is a weak acid hence partially ionized.

8. a) The heat absorbed by a substance as it changes from liquid state to gaseous state at constant temperature.

b) Boiling point increases with increase in molecular mass / c- atoms / c- bonds

9. a) A condenser/ lie big condenser

b) To show when vapour fractions are distilling off.

c) C

10. a) +5 / 5

b) 5 / V

11. The yellow phosphorous form liquid PCl3, The PCl3 is hydrolysed in air to form HCl which fumes.

12. a) $H_2O\ (g) + C(s) \longrightarrow CO(g) + H2$

b) Reducing agents, Fuel / methanol, synthetic petrol.

13. They combine with water vapour to form acid rain which corrode building, pollute/poisonous / bad smell / Nitrating / Acidifying sort.

14. The entire Soln turns pink/ purple; Potassium permanganate particles have diffused into water molecules or color spreads.

15. a) Add water to the oluem carefully

b) - Making NH_4SO_4 fertilizer

- Paints manufacture
- Manufacture of detergents
- Esters
- Explosives
- HCl acid
- Dehydration
- Drying gases

16. a) $3mg\ (S) + \overline{N_2\ (g)} \rightarrow Mg_3N_2(S)$

b) Argon / Neon (name of a rare gas)

Because they are inert and not likely to have reacted with any of the reagents.

17. **Chemical method** – Insert a glowing splint into a gas jar of gas G and find it absorbed it is not N_2O inverting in air, if it doesn't turn brown its N_2O

Physical – Invert gas G over cold water if the level rises the gas is N2O

(laughing gas, nitrous oxide or sweet sickly smell.

18. a) SO_4^{2-} , Sulphate ion

b) $Ba^{2+}\ (aq) + SO_4^{2+} \longrightarrow BaSO_4(s)$

c) $Zn\ (NH_3)_4^{2+}$

19. a) The high yield of ammonia decreases. At high temperatures ammonia decomposes and moves to the left OR shifts to the left.

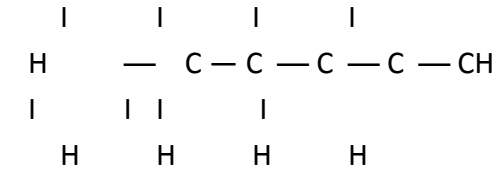
(Forward rxn is exothermic)

b) - Manufacture of fertilizer
- Softening temporary H2O
- Solvay process
- Removal of stains
- Smelting salts / manufacture.

20. - Door handles
- Coinage
- Soldering bits

- Padlocks
- Musical instruments
- Ornaments
- Making plumbing joints
- Cartridges for bullets and bombs.

21. a)



b) Alkanols / Alcohols.

c) $2C_4H_9OH\ (l) + 2k\ (s) \quad 2C_4H_9OK(s) + H_2(g) \quad C_4H_9OH_9(l) + K(s)$
$C_4H_9OK(s) + {}^1/_2\ H_2(g)$

22. a) FeCl2 or Iron (II) chloride.

b) The solution was basic / alkaline hence PH of 14.0 Excess HCl neutralized all the alkali and then the solution became acidic as HCl is acidic.

23. a) Bromine is decolorized (colorless)

b) 1, 2 –dibromopentane or 2, 3 dibromopentane.

24. Group 7 elements react by gaining electrons. A small atom has a high e- affinity. This trend decreases down the group.

25. a) At a constant temperature the volume is inversely proportional to pressure OR V a

$1 / p$, $V = K/p$

b) $3x1 = 2x\ V_2$

$V_2 = 3/2$ litres $/dm^3$ or $15000cm^3$

26. a) Ammonia being basic dissolves in water to form a basic solution

b) To prevent sucking back as ammonia is very soluble.

27. $63.5g = 2x96500$ $\qquad$ $1.48gm = 1.48x2x\ 96500$

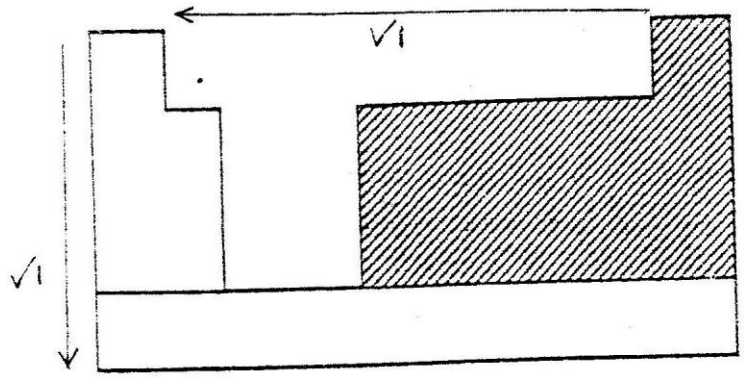
$1gm = 2x96500$ $\qquad$ 63.5

$1x2.5x60x60x60x1 = 1.48x2x96500$ $\qquad$ $q = 2.5 \times 60 \times 1$

$$I = \frac{2x1.48 \times 96500}{63.5 \times 2.5 \times 60 \times 60}$$

$I = 0.4998A$ or $0.5a$

CHEMISTRY PAPER 233/2 K.C.S.E 2003 MARKING



SCHEME.

1.a) Non-metals

b) i) KB/KF/KI/KA

ii) - Ionic /electrovalent bonding

- K loses an electron to form K- ions
- A gains electrons to form A- ions
- The ions combine to form KA

c) starting with aqueous magnesium sulphate, describe how you would obtain a sample of magnesium oxide. (3 marks)

Add an alkali solution to precipitate Mg $(OH)_2$, Filter; heat the residue to obtain MgO

OR

Add Na or K carbonate or hydrogen carbonate to form $MgCO_3$ ppt filter, heat the residue to obtain MGO

d) Both must be present and correct, do not accept one

$$Al(OH)_3(s) + OH\ (aq) \longrightarrow Alo_2\ (aq) + 2H_2O\ (l)$$

iii) Average rate in b (i) is higher than in b (ii). There are more particles between 0 and 2 mins than 6-8 mins hence the frequency of collision is higher.

c) $CaCO_3(s) + 2HCL(aq) \longrightarrow CaCl(aq) + H_2O(l) + CO_2(g)$

d) - Heating/ warming/increasing the temperature.
- Increase in concentration of HCL
- Crushing the marble chips into small pieces using powdered CaCO3/ Stirring e) - It becomes wet/ damp/ mas in increased

-The substance absorbs water from the atmosphere f) i) Calcium sulphate

ii) I Making plaster for building
II Preparation of CO2
III Manufacturer of ammonium sulphate (fertilizer)
IV Manufacture of cement
V Manufacture of plaster (with oil)
VI filter material for paper (with oil)

2 a) i) On the diagram, show with a (+) sign the positive terminal

ii) $Zn(s) \longrightarrow ZN2+ \quad +2e$

iii) -The cell does not produce any current// Bulb will not light // No light // ions are not mobile // the solid is a non-electrolyte.

iv)

advantage	disadvantage
- Portable	-Not rechargeable
- Cheap	- Cannot produce continuous supply of elec.
- Convenient to use	-Environmental pollution

b) i) Purple /violet fumes are produced// Iodine is produced //

$2I \longrightarrow I2 + 2e$

ii) quantity of electricity = It
= 0.5x2 x 60 x60
= 3600

Mass of Pb = $\frac{3600 \times 207}{1.2 \times 96500}$
=3.861g

3. a)

Chemical reaction	Nuclear reaction
Involves valency electrons	Involves the nucleas (P and N)
Rate of chemical reaction is	

Dependent on temp and pressure factors (eternal conditions)	Reaction's independent of external
No huge amount of energy involved	Huge amount of energy involved.
No change in mass	There is mass change.

b) (i) I alpha particle

III Beta particle

(ii) $^{210}_{84}PO \longrightarrow {}^{206}_{82}Pb + {}^{4}_{2}He$

Conventional way of writing

c) I 20 minutes (value to be read from graph +2)

II % value at 70 min from graph 9 % +2

$$\text{Mass} = \frac{0.16X100}{9}$$

(value must be read from the graph +2)

d) -Treatment of cancer

- sterilization of surgical equipment

-Regulation of heat pace makers

- detection of uptake of iodine 131 in kidneys.

4. a) Carbon dioxide is lost/produced/evolved

b) (i) $\frac{1.8-0}{2} = 0.9$ g/min

(ii) $\frac{-2.95}{2} = 0.125$ g/min

5 a) Electrolysis // Hall/ Heroult cell

b) Al_2O_3 . Al_2O_3. H_2O /al_2O_3. $2H_2O$

c) i) Iron (iii) Oxide Fe_2O_3 silica

Silica SiO_2

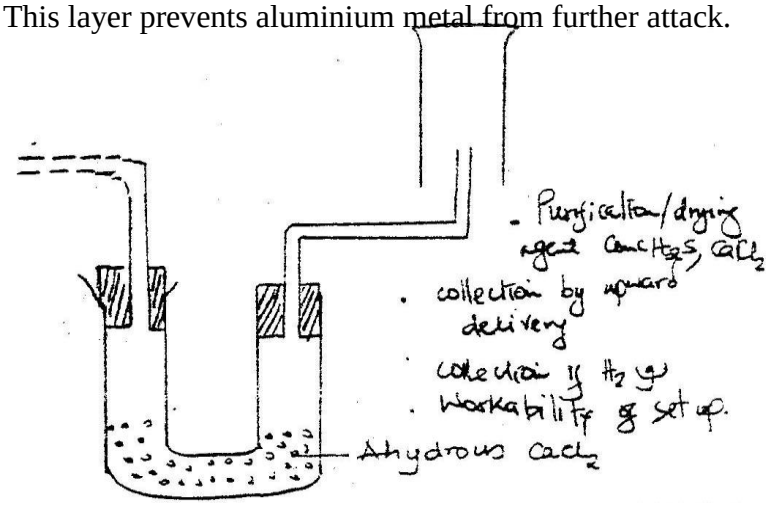
ii) Add hot cone. NaoH /KOH2, silca and AlO3 dissolves. Filter iron(iii) oxide. Bubble CO2 through filtrate/ add water/ add Al(OH)3 to precipitate. Al(OH)3. Filter al (OH)3 / silca remain in solution.

d) Lower melting point of Aluminum oxide/Acts as an electrolyte.

e) The oxide ion (O2-) is discharged at the graphite to form carbon dioxide

f) The reaction of aluminium with oxygen forms a firm layer of aluminium oxide.

This layer prevents aluminium metal from further attack.



$2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$

(c) (i) $Zn(s) + H_2SO_4(aq) \longrightarrow znsO_4(aq) + H_2(g)$

6. a)

b)

$$\frac{1.2}{24} = 0.05$$

Moles of Zn = 0.05

0.05 moles of zn = 0.05 moles

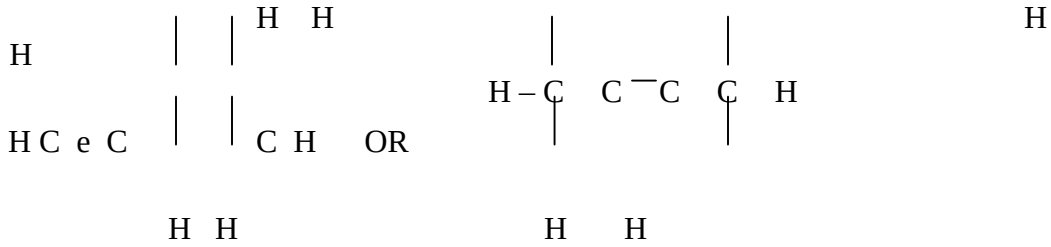
R.A. M $\frac{3.27}{0.05} = 65.4$ (N0 units)

d) - Manufacture of ammonia
- Extraction of tungstein
- Synthesis of HCL (acid) or HCL (gas)
- Filling weather balloons

- Making oxy-hydrogen flame for welding - Hardening of oil/manufacture of margarine.

7. a) Ethane burns with a pale blue flame while ethane burns with a yellow flame. Ethane is saturated while ethyne is unsaturated. OR Ethane burns with a non smoky flame while ethyne burns with a Smokey/sooty flame.

b)



c) (i) I Oxidation

II B -Ethane

C - Sodium ethanoate.

(ii) $CH_3 CH_2 OH_{(i)} + 30_{2(g)} \quad 2C02_{(g)} + 6H_2O$

(iii) to bring the reacting particles in close contract for the reaction to occur.

(iv) -Fuel

- Manufacturer of carbon black used in making paint and paint ink
- Manufacture of hydrogen gas
- Manufacture of carbon disulphide
- Manufacture of chloromethane, tetra chloromethane
- Manufacture of hydrogen used in manufacture of ammonia - Manufacture of hydrogen cyanide - Manufacture of ethyne.

CHEMISTRY PAPER 233/1 K.C.S.E 2004
MARKING SCHEME

1. Burning involves use of oxygen (1) the products include the mass of candle and oxygen

Oxidation increase in mass

Combined with oxygen (2mks)

2. a) Gas a is Nitrogen gas (i) (1mk)

b) Withdraw delivery tube from the water(1) This prevents sucking back (1) (2mks)

3. The energy required to remove the outermost electron is lower for B than for (1)

therefore B is more reactive than (i) (2mks)

4. a) Sulphur dioxide

Thistle funnel dip in the non mixture

b) (i) The gas escape through the thistle funnel (1)

-the gas should be shorter or rising ½ the delivery tube above the mixture.

5. Moles of BaCl2=600x 1 = 0.6

Heat change when 0.6 moles of BaCl2 are used = 17.7 x 0.6 (½) = 10.62KJ

1500 x 4 T = 10.62 (1) 1.5 x 4.2 x T 10.62

$$T = \frac{10.62}{1500 \times 4.2} \quad \text{or} \quad \frac{10.62}{1.5 \times 4.2}$$

= 1.68570+

=

1.7 1.6857 or 1.7

6. In diamond each carbon atom is covalently bonded to four other carbon atoms in a rigid giant atomic structure (1)

In graphite each carbon atom is covalently bonded to three other carbon atoms in layers(i)

The layers are held together by weak van der walls forces which are broken quite easily (1)

7. (a) Is the charge that atoms have in molecules/icons (l) (2mks)

(b) -3

8. a) (i) KOH (l)

b) Plants need potassium on a large-scale macro scale therefore the ash contains mainly K_2O or potassium compound.

9. working out the differences between any two consecutive alcohols (1) . There is a constant increase in mass caused by constant addition of CH_2

OR

This is a homologous series in a constant increase in mass. (3mks)

10. It is required to break the strong N= N bond

It is required to break the triple bond. (3mks)

11. a) Heat high temperature

b) (i) Gas A is sulphur dioxide(1) SO_2 electro plating

(ii) In batteries (1)

- Galvanizing iron
- Making allow brass
- Electroplating
- To make zinc oxide use for paints cement

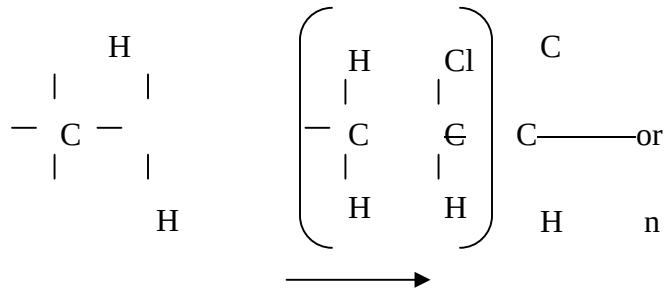
- Rubber treatment
- For making cement
- Paints

12. Add aqueous ammonia (1) to form AI(OH) 3 (½) filter (½) and dry in a des cater or sun(i) in low temp.

    If a candidate writes day in the oven award one more if they say at low temperature.

13. (a) Monomer (1)

(b)



14. a) $Mg2+_{(aq)} + CO_3^{2}{}_{(aq)}$ $MgCO_{3(s)}$ (1) penalize ½ more for missing state symbols

    (b) RFM of $Mg CO_3$ = 24 + 12 + 48 =84 (½)

    = 24 + 12 + 16 x 3 (½)

    Moles of Mg2+ = $\frac{8.4}{8} = 0.1$ (½) $\frac{0.1}{1000} \times 0.5$ = (½)

    $X = \frac{1000 \times 0.1}{0.5}$

    (c) = Test tube 1: There is effervescence (½) bubbler/ dissolved

    Test tube 2: No effervescence (½) no observable change/dissolved

    Ethanoic acid ionizes in water (1)

    H reacts with CO_3^{2-} to form CO_2 (l)

    In Hexane ethanoic acid exists in form of molecules. No reaction with carbonate or acide does not ionize in balane. (3mks)

16. a) F and J (1mk)

    b) HFJG (2mks)

17. Butane, But – I – ene (1mk)

18. a) solid changes from brown to grey(l) or Brown solid to black

    Original colour must be stated (1mk)

    b) $Fe_2O_3 + CO_{(g)}$ $2FeO_{(s)} + CO_{2(g)}$

The colour of the soil disappears and Q disappears/reduces (2mks)

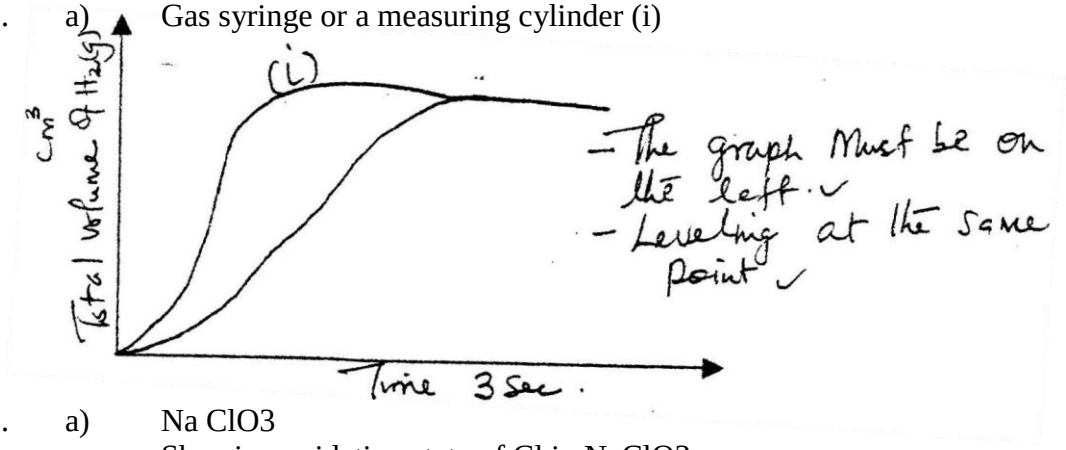
19. a) The colour of the solution fadws(1) solution turns colorless/solid Q dissolves Brown solid is deposited on the surface of Q solid Q dissolves/diminishes/ Q goes into solution.

b) Metal Q is more reactive than CU: displaces CU from solution (1) (3marks)

20. Neutron – proton ratio

Amount of energy released during isotope decay (l)

21. a) Gas syringe or a measuring cylinder (i)



22. a) Na ClO3

Showing oxidation state of Cl in NaClO3

Showing Oxidation state of Cl in NaCl(1)

Oxidation involves loss of electrons (½)

To product is NaclO3 (½) increase in oxidation no from 0 to 5

NaClO3 oxidates state or +5

23. Water in test-tube 2

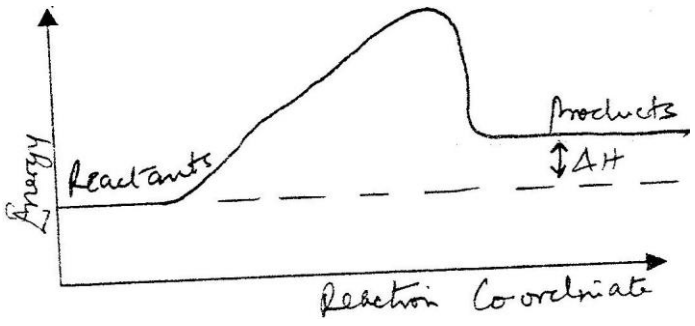
Soap reacts with Ca^{2+} or Mg^{2+} in hard water

Soap reacts with Ca^{24} or Mg^{24}

24. a) A solution containing H^+ ions a solution that turns paper red all les than 7 solution that neutralizes bases for form salt and water only reacts to produce H2 proton.

b) $pb^{2+}{}_{(aq)} + CO_{3(aq)}$ $pbCO_{3(s)}$ (2Mks)

c) a)



d) Endothermic (1) products are at a higher energy level than the reactants.(1) 26.

1) Bulb does not light ($^1/_2$)ions present

27. (a) 4 and 5 blue and Green (full) $H_2SO_{4\ (aq)}$ is on electrolyte

(b) 2 and 3 (1) yellow and red

(c) Yellow and red (1)

4 – Blue

5 – Green

2 – Yellow

3 – Red award it the colour is tied to the number (3mks)

CHEMISTRY PAPER 233/2 2004

MARKING SCHEME PAPER 2

1. (a) (i) Green/ yellow gas

(ii) Slightly soluble/ soluble (Rej highly soluble

(iii) Violet/ purple/ grey/ black solid

(b) (i) $4HCl_{(aq)} + MnO_2(s) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$

OR

$Mn)_2(s) + 4H^+ + 2Cl^-(aq) \rightarrow Mn^{2+}(aq) + 2H_2O(l) + Cl(g)$

OR

$4HCl(aq) \rightarrow 4H^+(aq) + 2Cl(aq)$

(ii) To oxidize the chloride ions to chlorine gas/ oxidizing agent

(c) (i) Iron (III) chloride/ $FeCl_3$

(ii) Mass of chlorine used = 0.06 – 6.30 = 1.76

R.m.m of Cl_2 = 71

Moles of chlorine = $\frac{1.76}{71}$

= 0.0248 x 24000

= 595. 2 cm^3

Or moles of $FeCl_2$

$\frac{6.30}{127} = 0.0496$

Moles of $FeCl_3$

$\frac{8.06}{162.5} = 0.0496$

Moles of $Cl_2 = \frac{0.0496}{2} = 0.0248$ moles

Volume of Cl_2 = 0.0248 x 240 = 595. 2 cm^3

Alt

$2FeCl_2(aq) + Cl_2(g) \rightarrow 2FeCl_3(s)$

$\frac{6.30 \times 24000}{254}$

= 595. 2 cm^3

$\frac{8.06 \times 24000}{325}$

= 595.2 cm^3

Structure

H H

I I

(d) Cl - C - C - Cl

I I

H H

Name 1,2 dichloroethane (rej) Dichloroethene)

Cl Cl

I I

Cl - C - C - Cl (accept Hexachloroethane)

I I

Cl Cl 1,1,1,2,2,2, Hexachloetahne

(e) Manufacture of HCl

Manufacture of PVC

Manufacture of insecticides

Manufacture of chloroethane

Disinfectants

Manufacture of antiseptic

Bleaching powder, DDT, Tetrachloromethane, Chloroform

Reject – manufacture of plastics

2. (a) (i) hydrogen gas / H_2

(ii) $Ca(OH)_2$ is slightly soluble in water // only a few OH^- a re produced in solution

(iii) It is used for testing presence of CO_2 used in prep. Of ammonia // calcium Oxide

(b) (i) Step 2 Carbon dioxide // CO_2

Step 4 Dil. Hydrochloric acid

(ii) $Ca(HCO_3 (aq) \rightarrow CaCO_3 (s) + CO_2 (g) + H_2 O(g)$

(iii) Add an aqueous solution of sulphuric acid. Add aqueous $NaSo_4$/ K_2SO_4 H_2SO_4 / $(NH4)_2SO_4$; Filter to obtain calcium sulphate as residue. Heat the residue to Dryness

Reject conc. Sulphuric acid // accept all aqueous sulphate // rej solid sulphate. Accept add sulphuric acid

3. (a) Accept outermost pipe

(b) (i) Platinum/ vanadium (v) Oxide

(ii) I The yield decreases. The extra heat decomposes or the forward rxn is exothermic/ equilibrium shifts to the left. Rej. Forward rxn is favoured

II Yield increases. There is increase in pressure/ equilibrium shifts to the right

(iii) Dissolve in Conc H_2SO_4 to make oleum. The Oleum is diluted with water to make sulphuric acid.

Accept equation

$SO_3(g) + H_2SO_4(l) \rightarrow H_2S_2O_7$ (l

$H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(l)$

(c) Formation of acid rain

It is poisonous / Harmful

(d) (i) $2NH_3(g) + H_2S)_4(l) \rightarrow (NH_4)_2SO_4(s)$

(ii) $2NH_3(g) + H_2SO_4 \rightarrow (NH_4)_2SO_4(s)$

R.m.m of $H_2SO_4 = 98$

R.m.m of $(NH_4)_2SO_4 = 132$

Moles of fertilizer = $\frac{25}{132} \times 1000$

= 189.4 or 189.3

Moles of $H_2SO_4 = 189.4$

Mass of $H_2SO_4 = \frac{189.4 \times 98}{1000}$

= 18.56 KG

Mass of $H_2SO_4 = \frac{25 \times 98}{132} = 18.56$ kg

4. (a) A solution which cannot dissolve any more solute at a particular temperature

(b) (i) Horizontal scale / label and covering 4 big squares ½ mk

Vertical label and covering 4 big squares ½ mk

Plotting - six correct points plotted 1

- Five correct points plotted ½
- Smooth curve 1 mk

Value read from the graph (+)

Penalise ½ mk for no units

(ii) I 25/100g

II Mass dissolved = 62g

Mass of undissolved = 80 – 62 = 18g

(c) R.F.M of $KNO_3 = 101$

Moles of KNO_3 in 100g water = $\frac{25}{101} = 0.2475$

Moles is 100g of water $\frac{0.2475 \times 1000}{100} = 2.475$ Accept 2.481

Accept moles of KNO_3 in 100g of water = $\frac{25}{101} \times 10$

5. (a) (i) Heat (Rej. Warm)

(ii) I Reagent K K_2CO_3 (aq) / $NaCO_3$ (aq) / $(NH_4)_2CO_3$

II Gas Q Oxygen

III S Nitric acid/ HNO_3

R Nitrous acid / HNO_2

(iii) I $Pb(OH)_4^{2-}$(aq)

II $PbP_{(s)} + H_2(g) \rightarrow Pb_{(s)} + H_2O_{(l)}(g)$

(b) (i) Cheap, corrosion resistant/ durable/ lead is poisonous/ Flexible

(ii) Lead is poisonous/ harmful

(c) (i) The reaction produces insoluble lead (II) sulphate which coats the surface of $Pb(NO_3)_2$ preventing further constant (mention of lead nitrate is a must.)

(ii) KNO_3 / $NaNO_3$

6. (a) (i) Fractional distillation

(ii) Molecular mass/ density

Boiling point

(b) (i) C_3H_6

(ii) Shake a sample with bromine C_3H_8 does not decolourize. C_3H_6 decolourizes. Or use acidified potassium permanganate C_3H_8 does not decolourize C_3H_6 decolourizes. (Reject chlorine)

OR

Burn a sample of C_3H_8 burns with a non- luminous flame. C_3H_6 burns with luminous

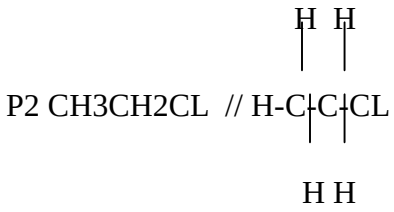
Alternative

Use acidified potassium Dichromate – C_3H_8 does not change Orange potassium dichromate. C3H6 turns acidified potassium dichromate from orange to green.

H H

| |

a) P1 CH2CHCL // H-C =C-CL

P2 CH3CH2CL // 

d) (i) Ethanol / C2H5OH /CH3CH2OH

(ii) Slightly soluble in water/insoluble in water.

a) Name of polymer- Polythene

Disadvantage of polymer – It is non-biodegradable/ pollutes the environment produces poisonous gases when burned.

7. a) add aqueous sodium carbonate to precipitate calcium carbonate and magnesium carbonate and filter.

b) i) I cathode: $2H^+(aq) + 2e \rightarrow H_2(g)$

II Anode $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

ii) I Sodium Hydroxide/ NaOH

II Graphite/platinum rej carbon.

III sodium chloride/ Nacl

(ii) To prevent mixing of chlorine gas with sodium hydroxide. To allow free movement of ions. It prevents the mixing of chlorine gas and hydrogen gas.

(c) In paper industry

Manufacture of soap/detergents

Used to make bleaching agents

Used to make bleaching agents

Used in purification of bauxite

CHEMISTRY PAPER 233/1 2005
MARKING SCHEME PAPER 1

1. Used in the manufacture of glass, treatment of hard water, making of baking powder preservation of soft drinks etc. (1mk)

2. Hydrogen chloride reacts with calcium oxide in the presence of water to form calcium chloride.

$CaO(s) + 2HCl(g) \rightarrow CaCl_2(aq) + H_2O(l)$ (2mks)

3. (a) Carbon dioxide gas

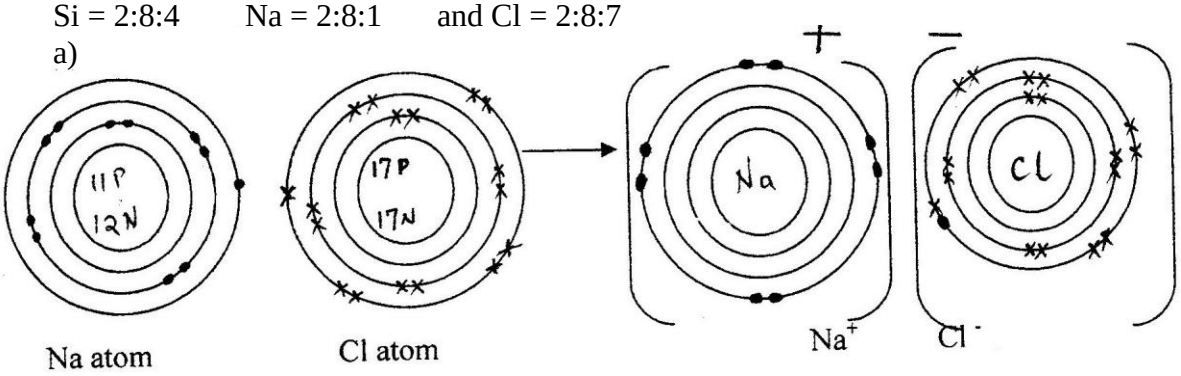
(b) Temporary hard water dissolves hydrogen carbon salts which decomposes on heating to produce carbon dioxide

Heat

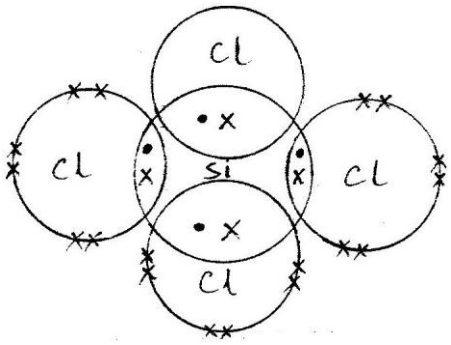
$Ca(HCO_3)_2\ (aq) \rightarrow CaO_3(s) + H_2O(l) + CO_2(g)$

4. Si = 2:8:4 Na = 2:8:1 and Cl = 2:8:7

a)



b)



Silicon (IV) Tetra Chloride

5. (a) (i) $ZnO(s) + H_2SO4(aq) \rightarrow ZnSO_4(aq) + H_2O(I)$

(ii) $ZnO(s) + 2NaOH(aq) \rightarrow Na_2ZnO_2(aq) + H_2O(l)$

(b) Basic oxide

6. (a) B and F

They are isotopes i.e. atoms of the same element with same mass number but different atomic number

(b) Mass number = Atomic number + No. of neutrons

7 = 3 + n

7 = 3n

N = 4

7. H-C ≡C- H+ C12 → Cl H C ≡ C H Cl

1,2 Dichloro ethane

8. Let the oxidation state of S be X:

(a) H_2S: $2H^+ + S^x = 0$

$+ 2 + x = 0$

$X = -2$

(b) $S_2O_3 = -2$

$2x + 3x - 2 = 2$

$2x + 6 = 2$

$2x = 4$

$X = 2$

9. $GCO_3(s) + 2HCI\ (aq) \rightarrow GCl_2(aq) + CO_2(g) + H_2O(l)$

1 mol 2 mol

Moles of acid used = $\frac{20}{1000} \times 1 = 0.02$ moles

Of the carbonate = ½ of acid = 0.01 moles

0.01 moles = 1 g

1 mole = $\frac{1 \times 1}{0.01} = 100g$

Molar mass of GCO_3 = G + 16 x 3

100 = G + 60

G = 40

R.A.M of G = 40

10. The reaction has stopped as substance H has all been converted to J yet the time is continuing

11. (a) $2NaOH(aq) + 2\ Cl_2(g) \rightarrow NaOCI_3\ (aq) + NaCl\ (aq) + H_2O(l)$

(b) Manufacture of bleaching agents

12. (a) Coke reduces lead (II) oxide to lead metal $Pb(s) + C(s) \rightarrow Pb(s) + CO(g)$

(b) Limestone (calcium oxide) combine with Silica to form Calcium Silicate

$CaO(s) + SiO_2(s) \rightarrow CaSiO_3$

(c) Scrap iron reduces any remaining lead sulphide to lead metal $Fe(s) + PbS(s) \rightarrow FeS(s) + Pb(s)$ 13. From the equation:

1 mole of metane produces 890kj

Hence 890 Kj = 24 litres

111.25 KJ = 111.25 x 24 litres

= 3 litres

14.

Year	Mass (g)	
0	100	
5.2	50	1st half- life
10.4	25	2nd half- life
15.6	12.5	3rd half - life

Let half- life be x

3x = 15.6

X=5.2 yrs

15. Graphite structure is layered with layers together by weak vander waals force. These forces are easily broken making layers to slide over each other hence good lubricant

16. Increases atomic radius results in decrease of 1st ionization energy

Increasing the radius, decreases the force of attraction from to the outermost electron. Hence decreasing in the 1st ionization energy down the group.

17. a) When the rate of forward reaction is equal to the rate of backward reaction.

b) The equilibrium shift to the right potassium hydroxide reacts with Carbon dioxide concentration of CO_2

18. a) Source of heat

b) The solid $pbBr_2$ melts to form pb2+ and 2Br- that conduct electric current in the circuit. Hence the bulb lights.

19. a) Molar heat of fusion

b) $-\Delta H^3$ process to exothermic (heat given out to the sourrounding)

20. M is a strong acid while L is a weak acid.M has many ions in solution that take part in a reaction forming more product that L with few ions in solution.

21. a) Nitric acid is volatile hence turns into vapour while sulphuric acid is non – volatile

b) Sodium nitrate

c) Manufacture of fertilizers eg:NH_4NO_3

Manufacture of explosive eg: TIN Any of the four

Manufacture of dyes and drugs

Treatment of metal

22. a) N is Sodium ethanoate (CH3COONa)while P is methane (CH4)

b) Substitution reaction

23. $C_{(s)} + O2_{(g)} \rightarrow 2CO_{(g)}$

$Fe_2O_3 + 3CO(g) \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$

24. a) A yellow deposit of sulphur and a colourless liquid are formed.

b) The experiment should be performed in a fume chamber as both the reactants are poisonous.

25. a) Copper (II) ions

b) Tetra ammine copper ions (Complete salt)

26. No.of coulombs = 0.82 x 5 x 60 x 60
= 14760 coulombs

14760C = 2.65g

96500 C = $\frac{96500 \times 2.65}{14760}$ = 17.3255g

2.65g = 14760C

52g = $\frac{52 \times 14760}{96500}$ =

27. a) Reduction

b) i) Removal of oxygen from a substance is a reduction

ii) Lead ion has gained electrons to become lead metal gain of electron(s) is a reduction.

c) Hydrogen sulphide

28.

Products	CO_2	H_2O
Formula mass	44	18
No. of moles	Mass / R.F.M	Mass / R.F.M
	$\frac{4.2}{44}$	$\frac{1.71}{18}$
	0.095	0.095
Mole ratio	= 1	: 1

The masses of carbon and hydrogen in CO_2 and H_2O formed

Products	Carbon (CO_2)	Hydrogen (H_2O)
	$\frac{12}{44} \times 4.2$	$\frac{2}{18} \times 1.71$
	1.145	0.19
No. of moles	$\frac{1.145}{12} = 0.095$	$\frac{0.19}{1} = 0.19$
Mole ration	$\frac{0.095}{0.95} = 1$	$\frac{0.19}{0.095} = 2$

Therefore the empirical formula is CH_2

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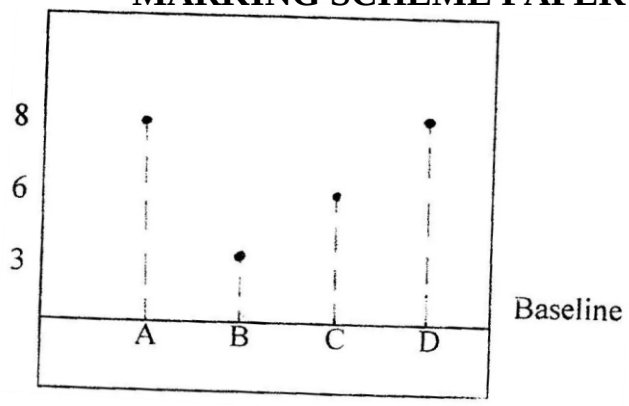
MARKING SCHEME PAPER 2

1. a) (i)



(ii) A and C

b) Since NH_4CL_4 sublimes but CaCl2 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 = $\frac{40}{1000} \times 0.5$ 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

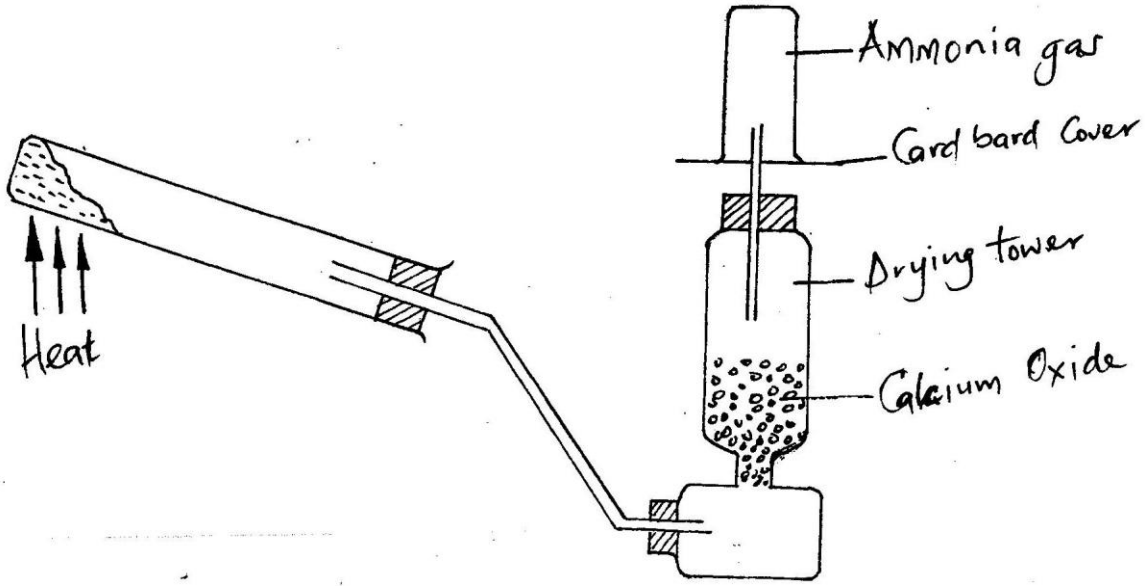
= 16g

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 = 144750 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.

20. 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 containing calcium and magnesium ions	Forms a scum with water and detergents
$R - SO_3 - Na^+$	They do not form with Ca^{2+} and Mg	They are made from petroleu products or vegetable oils wh are expensive.

(c) (i) Easters

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

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

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

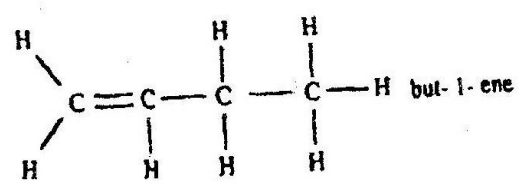
$Na(s) + O_2(g) \xrightarrow{\text{Excess}} Na_2O$

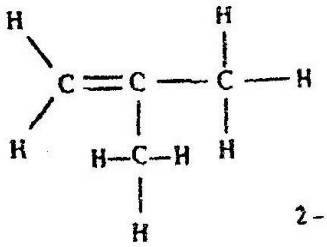
(e) Making Sodium compounds e.g. Sodium Cyanide, NaCN, which is used in the extraction of gold, make lead alloy, sodium & Potassium alloy is used as a "coolant" in nuclear reactors. (Accept any two)

KCSE 2006 CHEMISTRY PAPER 1 (233/1)
MARKING SCHEMES

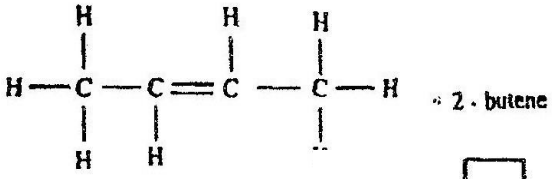
1 a) Compounds with the same molecular formula but different structural formulae. (1mk)

b)

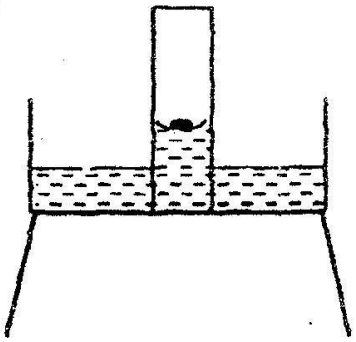




2 – methylProp - 1 - ene



2 a)



b) Calibrate athe gas jar before the start of experiment (1mk)

3. Time for SO_2 / Time for O_2

$$= \sqrt{\frac{R.M.MSO_2}{R.M.MO_2}}$$

R.M.M of SO_2 =64
R.M.M of SO_2 = 32

Time for SO_2 / 50

$$= \sqrt{\frac{64}{32}}$$

Time for SO2 = 70.7 seconds (3marks)

4 a) 37 + 0 → 37

$18^{A} - 1^{e}$ 17^{B}

b) i) Studding rate of absorption of phosphorus from a fertilizer (1mk) ii) May result to babies with deformities

May cause cancer (1mk)

5 a) In solid state - Does not conduct
Ions are fixed (1 ½ mks)

b) Aquous solution - Conducts
Ions are mobile (1 ½ mks)

6. a) $C_{(s)} + 2H_2SO4(g) + 2H2O\ (l) + 2SO2_{(g)}$ (1mk)

b) Carbon changes from 0 to +4 .. Oxidation has taken place

Sulphur changes from +6to +4.. Reduction has occurred (2mks)

7. a) Refrigeration (1mk)

b)

- They deplete the ozone layer.
- They cause green house effect. (2mks)

8. Mass of water 94.5 – 51.3 = 43.2

R.M.M. of Ba(OH)2 = 171

R.M.M of H2O = 18

$\frac{51.3}{171} \quad \frac{43.2}{18} = 8$

$0.3 = 1 \quad \frac{2.4}{0.3} \quad 8$

9. a) Mass

Pale yellow intensifies.

Forward reaction is exothermic

Lowering temperature shifts the equilibrium to the right. (1 ½ mks)

b)

Pale yellow intensified

Reducing the volume of syringe.

Increases the pressure

The equilibrium shifts to the rights.

10. a) sublimation (1 mk)

b) Bleaching. (1mk)

c) Polymerisation (1mk)

11 a)

Acidify water with nitric acid.

Add aqueous lead nitrate.

Formation of white PPt shows presence of CT

b) provides essential minerals e.g Ca2+ (1mk)

12. $\frac{62.93 \times 69.09 + 64.93 \times 30.91}{100}$

= 43.4783 + 20.0698

= 63.548 (3mks)

13. a) It is a drying agent. (1mk)

b) $Fe_{(s)} + 2HCL_{(g)} \quad FeCl_{2(s)} + H2(s) + H_{2(g)}$ (1mk)

c) Picking of metals (1mk)

14. a) N_2O

b) K_2O (1mk)

c) Al_2O_3 (1mk)

15. a) N (1mk)

b) Eø =0.80 +0.76

= 1.56 volts (1mk)

16 a) The solution changed from brown/yellow to light/pale green. (1mk)

b) $2FeCl_{3(aq)} + H_2S_{(g)} \quad FeCl_{2(aq)} 2+2HCl_{(aq)} + S_{(s)}$ (1mk)

c) Oxidation. (1mk)

17. a)Platinum

Platinum- Rhodium (1mk) b) $4\ NH_{3(g)} + 5O_{2\ (g)}\ 4\ NO_{(g)} + H_2O$ (1mk)

c) Fertilizers

Explosives (1mk)

18. add anhydrous copper(II) Sulphate to substance S. It changes from white to blye

OR

Dip cobalt chloride paper into Substance s. It changes from blue to pink. (2mks) 19.

a) To M_gO and excess HCl or H_2SO_4. Add NaOH or KOH to the mixture.

Filter and dry the residue.

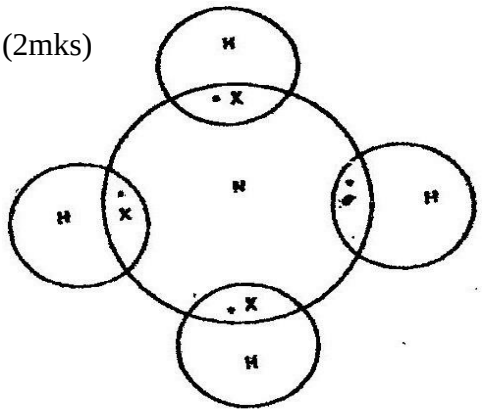
(2mks)

b) Anti-acid (treatment of acid indigestion) (1mk)

20 a) Covalent bond is formed by equal contribution of the shared electrons by the atoms. Co-ordinate bond is where the shared electrons are contributed by one

b)

(2mks)



21. a) They have delocalized valency electrons (1mk)

b) Aluminium has three delocalized electrons.

It is resistant to corrosion (2mks)

22. a) Oxalic acid and Conc. H_2SO_4 (1mk)

b) 2

$KOH_{(aq)} + CO_{2(g)} \longrightarrow K_2CO_{3(aq)} + H_2O_{(l)}$ (1mk)

c) CO is odourless

Co is colourless (1mrk)

23. In addition to van der waals forces, strong hydrogen bonds exist in ethanol.

These bonds require more energy to break (2mks)

24. a) Acidic Basic

Orange Pink (1mk)

b) The PH of 0.1 M KOH is higher then that 0.1 M aqueous ammonia.

KOH is strongly dissociated in solution (1mk)

25. a) V_1 and V_3 (1mk)

b) Add petrol to the mixture. Filter. V_2 is the residue. Filtrate is V_4 (2mks)
Distill the filtrate.

26. a) They gain energy and move faster. The intermolecular distance increases. (1mk)

b) XY (1mk)

c) The energy supplied changes molecules of water from liquid to Gaseous state.

(1mk)

27. a) Conc. H_2SO_4 (1mk)

b) Heat the solution to concentrate it. Allow for crystal for form. Filter.

C) Anhydrous copper(II) Sulphate (1mk)

28. a) H_1 = Lattice energy

H_2 =Hydration energy (2mks)

b) H_3 = H_2 (1mk)

K.C.S.E 2006 CHEMISTRY PAPER 2 (233 /2)

MARKING SCHEME

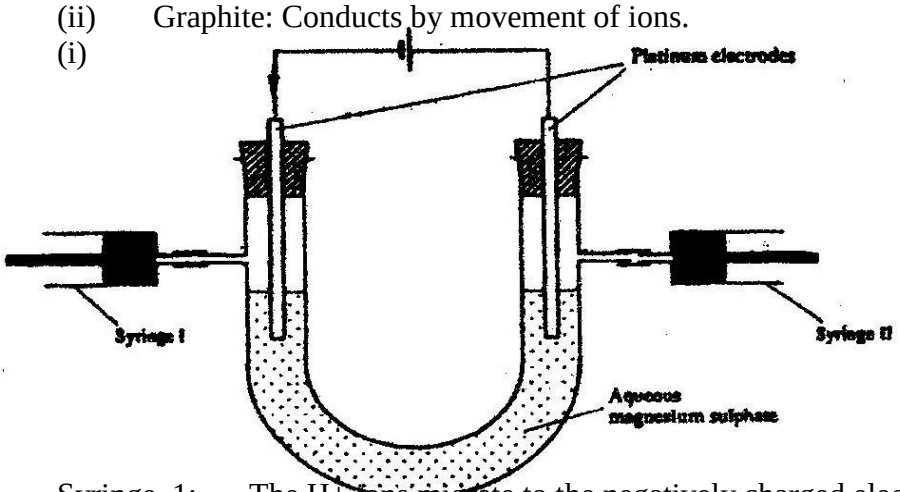
1. a) A substance that allows the passage of an electric current and is decomposed by it.

(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

$$4\ OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O2_{(g)} + 4e^-$$

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

Moles of oxygen produced = 0.006715

$= \frac{0.006175}{4}$

Volume of oxygen = 0.001675x 24000

= 40.2888cm3

$= 40.29\ cm^3$ (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

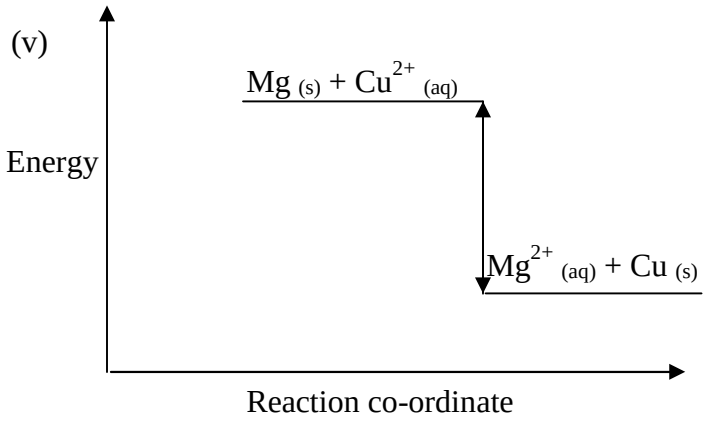
0.00625 = 1890 Joules

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

= -302.4Kj mol-1 (2mks)

(iv) $Mg_{(s)} + Cu^{2+}{}_{(aq)} \longrightarrow Mg^{2+}{}_{(aq)} + CU_{(s)}$ (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.

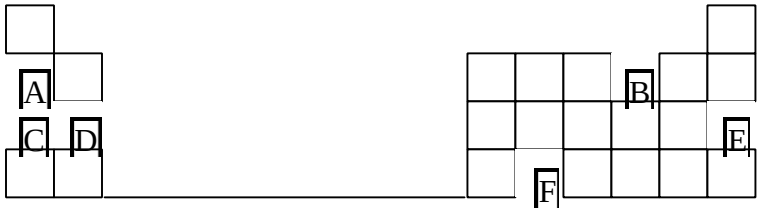
(2mks)

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) $\xrightarrow{\text{Heat}} 2NaNo_{2(s)} + O2_{(g)}$ (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.H2SO4 to react
Some SO2 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 ≡ 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) $CH_3COOH_{(aq)} + NaOH_{(aq)} \quad CH_3CO - ONa_{(aq)} + H_2O_{(l)}$ (1mk)

ii) HCl is fully dissociated while ethanoic acid dissociates partially

∴ Ethanoic acid is weak while HCL is strong(2mks)

6. a) i) Calcium silicate / calcium aluminate (1mk) ii) Magnetite,Fe_3O_4

Siderite,FeCO3 / Iron pyrites / iron limonite

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

iii) Carbon dioxide,CO2 /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 Fe2O3 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.

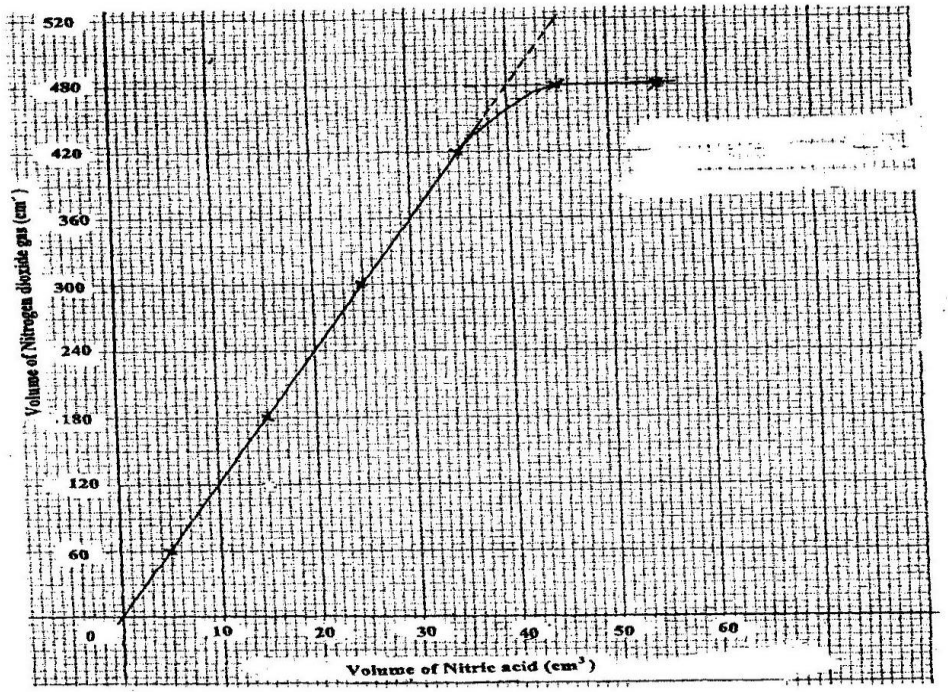
Drainage pipes

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 cm3 (Correct value read from graph) (1mk) ii) 40 cm^3 (Correct value read from graph) (1mk)

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

$$\therefore 1 \text{ mole of lead} = \frac{2.07}{0.01} \times 40$$

= 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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MARKING SCHEMES

1. (a) Carbon (IV) oxide

   (b) Blue flame, carbon (II) oxide is burning

2. Mass in $500cm^3$ = 15 x 1.05 = 15.75g

   Mass in $100cm^3$ = 15.75 x 2 = 31.5

   Molarity = $\frac{315}{60}$ = 0.103

3. (a) Group (VIII) elements

   (b) Chlorine molecule is smaller and the strength of vanderwaals forces between molecules of chlorine is weak as compared to iodine.

4. C- unburnt gas D- Luminous yellow flame

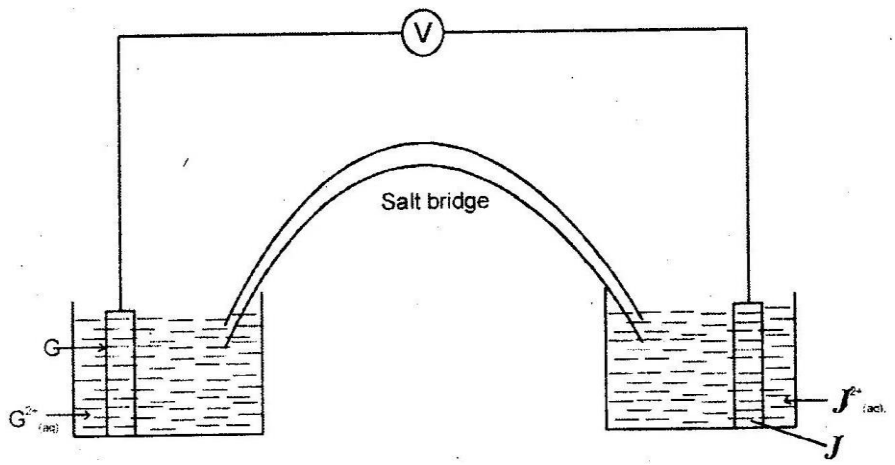
5. The product from nettle plant is acidic aqueous ammonia solution being basic neutralize the acidic product.

6. a) Colour change from green to brown.

   b) fe^{3+} 3OH → $Fe(OH)_3$

(aq) (aq)

(s)



7. a)

b) E^{θ} cell = E^{θ} reduced = E^{θ} oxidized

= -0.14V - - 0.74V = +0.6V>

15. Across the period there is a gradual increase in number of proteins in the nucleus. This increases the force as attracted between the nucleus and the electrons.

16. a) Dilute Nitric acid

b) Silver metal

c) oxygen

10. i) $H_2O_2(g) \rightarrow H_2O_2$ $\Delta H^{cc}_f = -133 kjmol^{-3}$ ii) $H_2O(l) \rightarrow H2_{(g)} + O2_{(g)}$ $\Delta H_f = +188 kmol^{-1}$ iii) $H_2O(l) \rightarrow H2O_{(g)}$ $\Delta H_f = +55 kjmol^{-1}$

11. It is denser than air>

It will react calcium oxide since CO_2 is acidic and CaO is basic.

12. a) The volume of a fixed mass of gas is directly proportional to its temperature is kevin.

b) $\frac{V1}{T1} = \frac{V2}{T2}$

$T2 = \frac{291 \times (1.0 \times 10^5) \times 2.8 \times 10^{-2}}{(1.0 \times 10^5) \times 3.5 \times 10^{-2})}$

2328 K

13. (a) (i) Deliquscency

(ii) Esterification

(iii) Thermal crucking

14. (a) Nuclear fusion is where two light nuclei combine to give a heavy release of energy while nuclear fusion is where a large nuclear splits into smaller nuclei with the release of enormous amount of energy.

(b) Wrap with aluminium or lead foil and bury them deep underground

15. (a) The calcium and magnesium compounds in this water can not be decomposed by heating i.e. $CaCl_2$, $CaSO_4$, $MgSO_4$ and $MgCl_2$

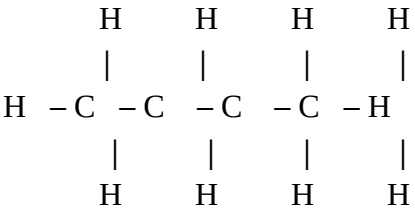
(b) Ionic exchange

Uses sodium carbonate (washing soda)

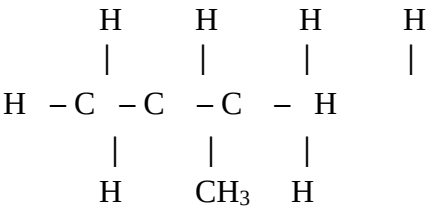
16. (a) O^0

(b) $[Zn(OH)_4]^2$

17.



Butane



Methyl Propane

18. React sodium with water to get sodium hydroxide

Bubble into this solution excess carbon (iv) oxide to get sodium hydrogen carbonate.

19. (a) Froth Floatation

(b) $ZnCO_3(g) \rightarrow ZnO_{(s)} + CO_2(g)$

(c) Manufacture of dry cells. Zinc casing forms the anode of dry cells

20. (a)

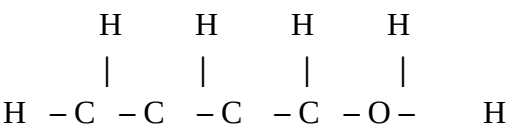
Element	C	H	O
%	64	21	13
	1	2 1	6
Mole	5.	4 1.	3 13
Ratio	n 4	1	

1

10

[E.F.= C_4H_9OH]

(b)



| | | |
H H H H

21. (a) Chlorine ions in Brime are high concentration compared to oxide ions in solutions
(b) Hydrogen gas

22. $Al_2(SO_4)_3 \rightarrow 3SO_{4-2} + 2Al^{3+}$

Moles a^2 Al_2 $(SO_4)_3$ = 6.84 = 0.02
342

Moles $a^2SO_4^{-2}$ = 0.02 x 3 = 0.06

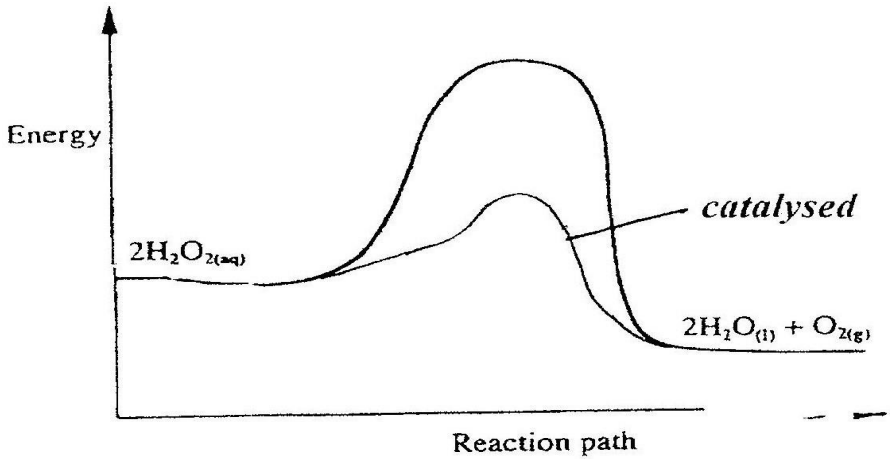
23. Pentene -1Al is polar. There are two forces, Vanderwaals and hydrogen bonds holding its molecules together. Pentene is non- polar.

24. White flames produced, Ammonia react with chlorine producing hydrogen chloride gas which react with excess ammonia to give ammonium chloride

25. (a) No change in volume since the number of moles of acid is equal in both cases.
(b) It is less dense and does not burn like hydrogen

26. (a) They are both metals and need to lose electrons to be stable
(b) $RCO_3(s) \rightarrow RO(s) + CO_2(g)$
(c) Q^{-3}

27.



28. (a) $Ag(a) + e^- AG(s)$
(b) Ce = 1t = 5.0 x 3 x 60 = 54000c
Mass of silver deposited

= <u>108 x 54000</u>

96500

= 60.44g

29. (a) Metallic bonding

(b) Group 1 Each atom contains one electron in its outer most energy level

30. The molecules which were inform of a ring open up to give chained molecules (S_8). This entangles each other reducing the flow of molten sulphur and increases its viscosity

K.C.S.E 2007 CHEMISTRY PAPER 2
MARKING SCHEMES

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

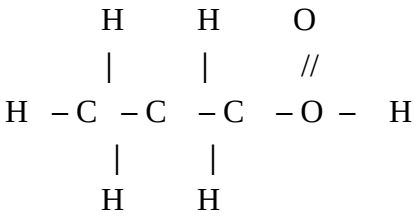
(c) **Step 1**

Fermentation: Glucose solution is mixed with yeast. The enzyme zymase from yeast converts glucose to ethanol

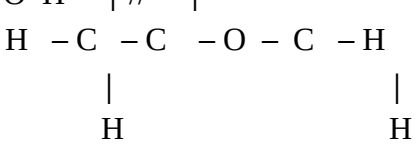
Step II

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 $CU(s) + 4HN)_3(aq)$ $CU(NO_3(aq) + 2NO_2(g) + 2H_2O(l)$

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.

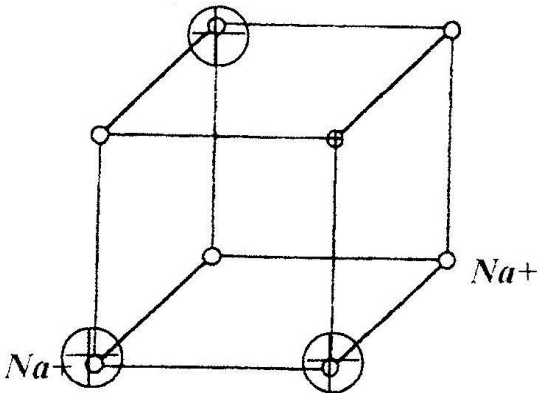
(b) (i) no. of seconds = 2 x 60 = 120 Sec

Moles of H202 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.

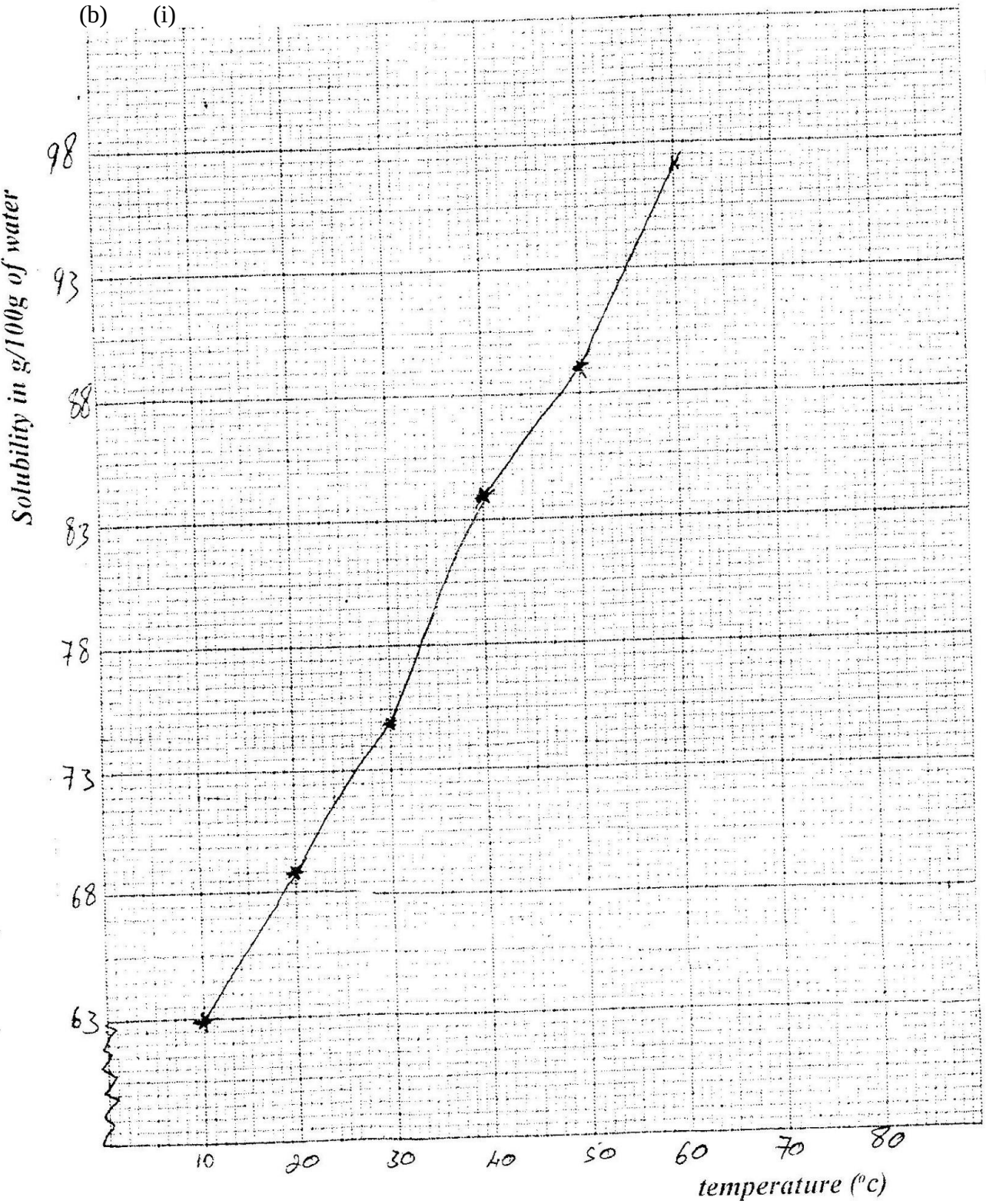
(ii) RMM of $(NH_4)_2 HPO_4 = 132$

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

(ii) 71g/100mm of water

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

(b) (i)



(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) = $1000 \times 71 = 41.52g$

171

(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.

CHEMISTRY PAPER 1

MARKING SCHEME 2008 K.C.S.E EXAMINATIONS

1. Crystal dissolves

Purple colour spreads in the water

The crystal break into smaller particles of potassium manganate (VII) which moves in all directions.

Crystals dissolves through diffusion

Purple colour of Km spread uniformly throughout the water KmNO4 diffused from the area of high con.

2. Mass of hydrated salt = (33.111 – 30.296)= 2.815g Mass of anhydrous salt = 32.781 – 30.296) = 2.485g

E.F = $CaSo_4$ 33. 111g

32 781g = 0.330

Mass of water = (2.815 – 2.485) = 0.330g

Accept any correct method

$CaSO_4$	x H_20
Mass 2.485	0.320
Moles 2. 485 = 0.0183	$^{0.330}/_{18}$ = 0.0183

Ration $^{0.0183}/_{0.0183}$ = $^{0.0183}/_{0.0183}$

Or; $CaSo_4. XH_2O \rightarrow CaSo_4 + XH_2O$

$\underline{2.815g} = \underline{2.485g}$

$CaSo_4 \times H_2O$ 136

$Y = \underline{2.815} \times 136 = 154$

2.485

$CaSo_4 \times H_2O = 154$

$136 + 18x = 154$

$18x = 154 – 136 = 18$

$X = {}^{18}/_{18} = 1$

3.

No	Gas	Test	Observation
I	Chlorine		The red litmus pare turns white/ the litmus paper i bleached
II	Acidified must be th	ePut a filter paper dipped in acidified potassium dichro (VI) into the gas	m
III			The bromine water is decolorized

4. (a) $C_{13}H_{27}COONa^+$ Regardless of charges i.e. $C_{13}H_{27}COONa$

(b) Soapy detergent/ soaps

(c) $(C_{13}H_{27}COO\text{-})_2$ Ca or $CI3H27COO)_2Mg^{2+}$

5. RFM of $Ca_3(PO_4)_2$ Ca=40 x 3 = 120

P = 31 x 2 = 62

O= 16 x 8 = 128
310

H_3PO4 H=1 x 3 = 3

P = 31 x 1 = 31 1 mole $Co_3(PO4)2$ gives moles of H_3PO_4

O = 16 x 4 = 64/98 310g Co_3 (PO4) 2 gives 2.98 g

155 x 100g Co_3 (PO4) gives $\frac{2.98 \times 155 \times 100}{310}$

= 98000g

= 98kg

6. Propanol Propan - I – ol

Butanoic acid

Are elements with the same atomic number but different masses

Are different elements with the same atomic no but different masses

7. (a) Atoms of the same element having different masses or atoms of the Same element having different number of neutrons.

(b) 18- 8 = 10 neutrons

8. (a) A black solid

(b) Fes (s) + 2 HCL(aq) → $FeCL_2$ (aq) + H_{2S}(g)

(c) The powder has a larger surface area than the iron fillings hence the Reaction is faster

9. Zn(s) + H_2SO_4 (aq) → $ZnSO_4$(aq) + H_2(g)

Zn(s) + $2H_2SO_{4\,(I)}$ → $ZnSO_4$(aq) + SO_2 (g) + $2H_20_{(l)}$

10. Magnesium burns in air to form Mgo and Mg_3N_2, Mg_2N_2 reacts with water to Liberate ammonia gas

Mg_3N_2(s) + 6 H_2O (I) → $2NH_3$ (g) + Mg $(OH)_2$(ag)

11. (a) Ionic/ electrovalent

(b) Has 7 electrons in its outermost energy level and hence easily gains an electron to complete the octet or it is most electronegative.

12. (a) Oxygen; O_2

(b) The Ph decreases

HoCL decomposes to give more HCL in the mixture

$2\ HOCL_{(ag)} \rightarrow 2\ HCL_{(ag)} + O_{2\ (g)}$

13. Pass product ever anhydrous copper (II) sulphate (I) which turns from white to blue (I) turns to blue or anhydrous copper (II) sulphate or use Cobalt Chloride (anhydrous which turns from blue to pink.

14. (a) A (I)

(b) A_1 (l) using baseline

15. J- the solubility of the substance decreases with increase with temperature it dissolves more in cold water than in hot water.

16. Heat the metal in air to form the oxide CUO

Add excess dilute HCL to the oxide to get $CUCL_2$

Concentrate the filtrate and leave to crystallize Filter and dry the crystals at room temperature between pieces of filter paper Add excess Cu to nitric acid (dilute concentrate) $K2CO_3$/ NH4 (Co_3)

Filter to remove unreacted copper. Add $Na_2\ Co_3$ to the filtrate to pp $CuCO_3$ filter and add dilute HCL to residue to obtain $CUCL_2$

Add nitric to obtain Cu (No3)2. Filter to remove excess CU. Add NaOH

17. (a) Amphoteric

(b) Lead (II), Zinc and Aluminium (any two)

18. (a) Position for silicon

(b) U

(c) $Q(s) + T_2\ (g) \rightarrow QT_2(s)$

$Mg(s) + CL_2\ (g) \rightarrow MgCl_2(s)$

19. (a) $Zn(s) / Zn^{2+}(aq) // Ag^+ / Ag\ (s)$

$Zn/Zn^{2+} // Ag^+/Ag(s)$

(b) The solution changes to blue because Cu metal is corroded dissolves to form Cu

(c) Metal silver is deposited on the sides of beaker BCO3 silver is deposited on the sides of beaker

$Cu(s) + Ag^+(aq) \rightarrow Cu_2(aq) + 2\ Ag(s)$

20. (a) At constant temperature and pressure, the rate of diffusion of a gas is inversely proportional to the square root of its density.

(b)

$$\sqrt{\frac{RW}{RX}} = \sqrt{\frac{RMMX}{MMWE}} \quad \sqrt{\frac{44}{16}} \qquad 12.0 = 44 \; ; \; \frac{12.0 \times 4}{48}$$

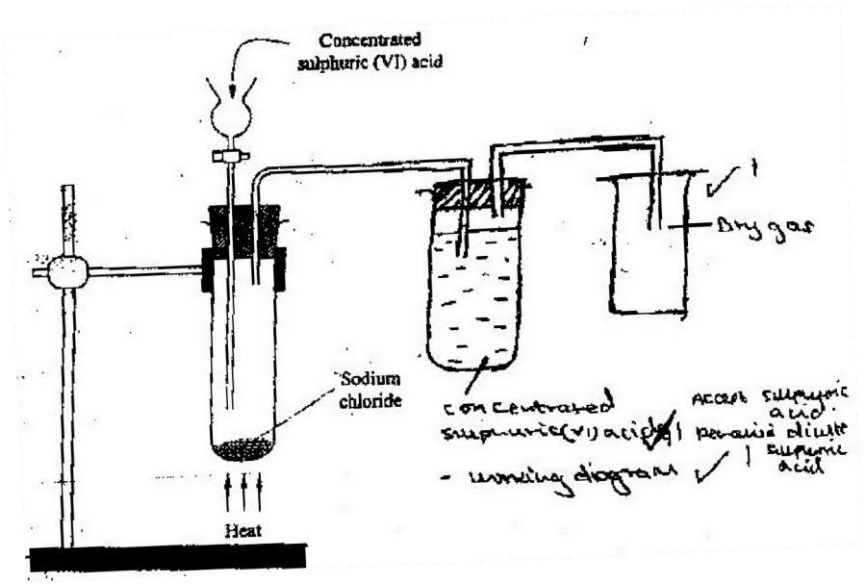
RX 4 44 6.63

=7.24 cm

21. a) Cu^{2+} moving towards the cathode

b) $4OH^-(aq) - 4e^- \rightarrow 2H_2O(l) + 0_2(g)$

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



22. Diagram (check)

23. The brown colour of the mixture intensifies / increases and the green colour of the mixture fades/ decreases or the yellow deposit/ sulphur decreases Iron (II) is converted to Fe^{3+}

Sulphur is converted to H_2S OR Equilibrium shift to the left.

24. (a) $^{4}_{2}He$ reject>, He, $^{4}_{2}He^{+}$

(b) (i) $Z_1 = 235$ $Z_2 = 54$

(ii) Nuclear fission
Accept fission

25. (a) Cooling

(b) Latent heat of fusion

26. (a) I Pb^{2+}

II $Co3^{2-}$

(b) $PbO(s) + 2H^{+}(aq) \rightarrow Pb^{2+}(aq) + H_2O(l)$

27. (a) $Mg(OH)_2(aq) + 2\ HCL\ (aq) \rightarrow Mg\ Cl_2\ (aq) + H_2O_{(l)}$

Mole ration (1:2)

No of moles of acid = $\frac{0.1 \times 23}{1000} = 0.0023$

No of moles of $Mg(OH)_2 = \frac{½ \times 0/1 \times 23}{1000} = 0.00115$

Mass of $Mg(OH)_w$ in antacid = $0.00115 \times 58 = 0.067g$

(b) % of $Mg(OH)_2$ in anti- acid

$Mg(OH)_2 = \frac{0.67}{0.50} \times 100 = 13.34\%$

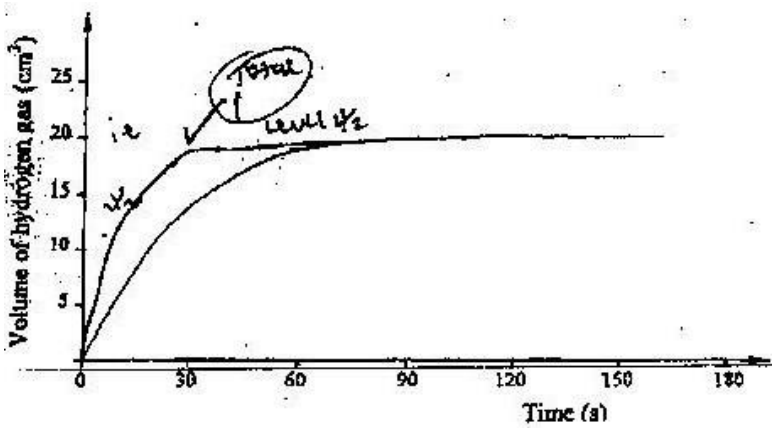
28. (a) (i) Cryolite

(ii) Electrolysis

(b) Good conductor does not rust
Malleable
Light
High m.p
Does not corrode easily

29. (a) Gas syringe/ graduated gas cylinder/ measuring cylinder

(b) (i)



(ii) The molecules of the reactants have higher energy marking points
The reaction is faster/ are more effective collusions

30. It burns to form SO2SO3 which is a pollutant
Accept any other effect e.g. – Acid rain
- Corrosion of buildings
- Irritation of respiratory systems
- Yellowing of leaves of plants

31. (a) Neutralization
(b) (i) Calcium hydrogen carbonate
(ii) Drying agent
Extraction of sodium metal

2008 K.C.S.E CHEMISTRY PAPER 2 (THEORY) 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 $(OH)_2$ CO_2 will be observed
Or CH4 will not be absorbed – measure volume (v_2)
CH_4 $\frac{\text{Volume methane}}{\text{Volume of biogas}} \times 100$

(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

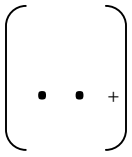
Therefore

I Across the period from left to right nuclear charge, exert greater pull on Electrons hence reduction in size.

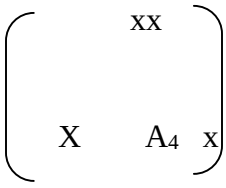
II A4 gains electrons, incoming electron is repelled by existing electrons, electrons cloud increases.

(iii) A2

(iv)



A_1 xx



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

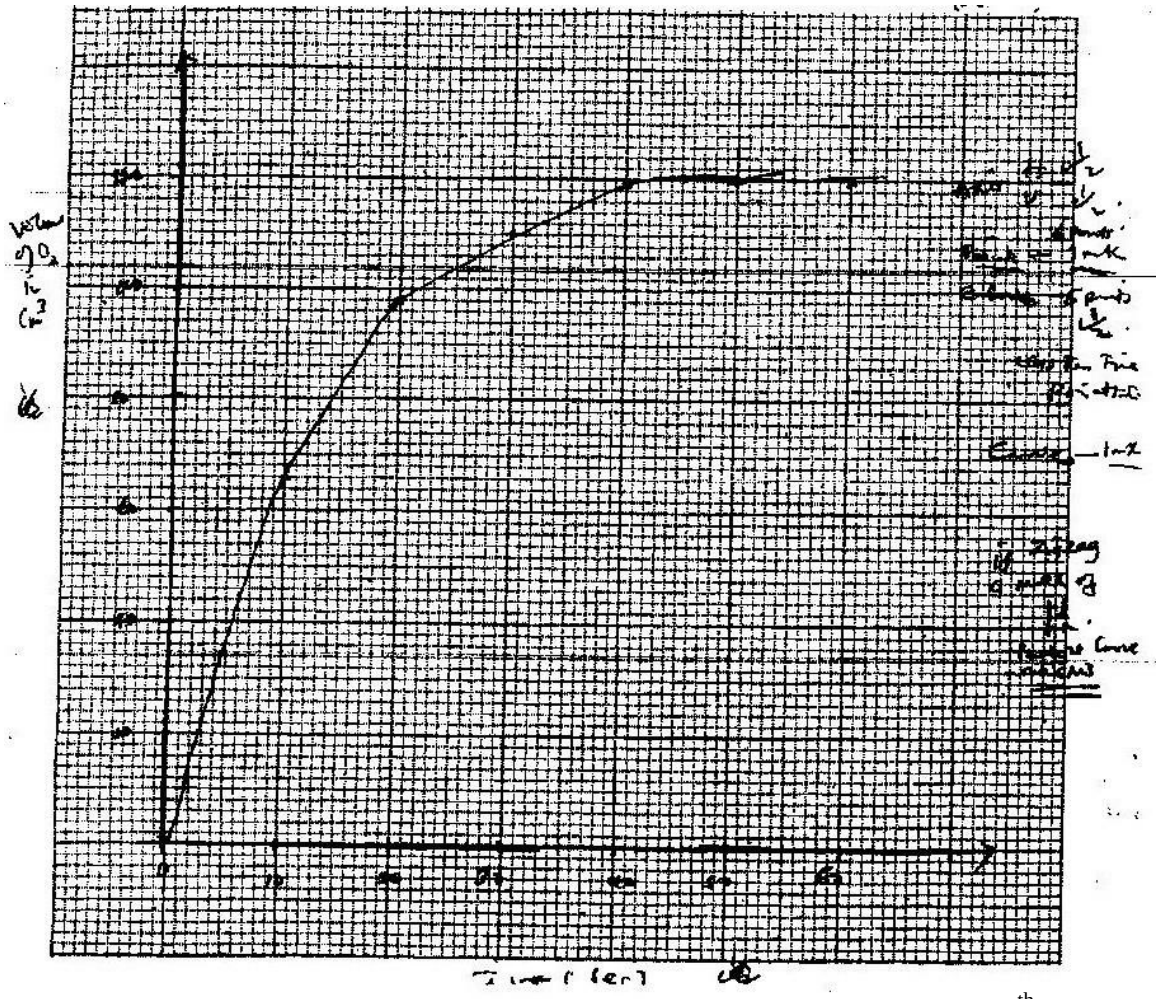
The moles/Volume/ molecules of gases is reactants and product are equal

(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



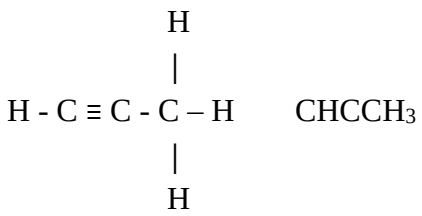
(iii) Drawing tangent at any time above 24 sec/ between 24th sec and 40 sec, correct use of tangent to calculate rate.

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
$CH_3CH_2C\text{-}O\text{-}CH_2CH_3C_5H_{10}O_2$

(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

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

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

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

96500

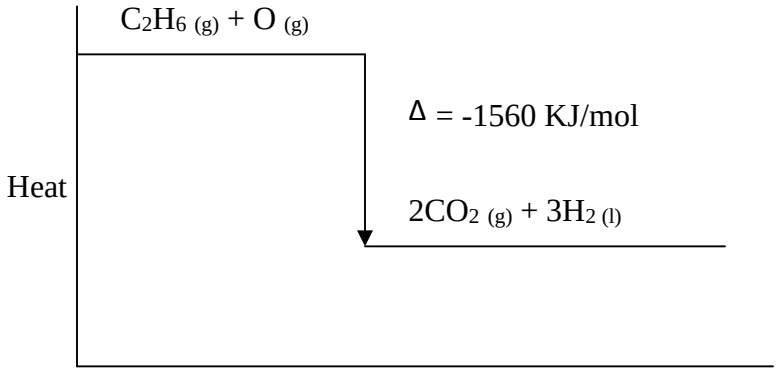
$\frac{0.005596 \times 108}{1}$ = 0.60g

(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)



Reaction progress

(iii) $2CO_2 + N_3H_2O_{(l)} \rightarrow C_2\,Hl_{(g)} + {}^{7}/_{2}\,O_2$ Δ 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 = $\frac{\text{Answer I}}{1560}$

/1560

= 0.02894 x 39
= 0.868

K.C.S.E

CHEMISTRY P1 2009

1. (a) Energy required to remove 1 mole of electrons from 1 mole of gaseous atoms (1 mk)

   (b) B (1) 418???

   It loses electrons most readily (l)

   Reject lowest i.e. $M_g (HCO_3) 2_{aq} \rightarrow M_g C_S O_3 + H_2O + CO_2 (_g)$

2. (a) $Ca (HCO_3)_2 (aq) \rightarrow CaCO_3(S) + H_2O(l) + CO_2 (g)$

   (b) Sodium carbonate (l) Soda ash/ washing soda

   Calcium hydroxide (l) / Lime water $_2$ Ammonia Sol;

   Sol; Sodium per mutito/ Sodium Duminium Silicate.

3. (i) 2.8.8

   (ii) 2.8.2

4. (a) Water (l)

   (b) The second / other product of burning candle is carbon (IV) oxide (l). It can be prevented from getting into the environment by passing it though a hydroxide solution/ alkaline solution e.g. K.O.H NaOH or aqueous ammonia (l).

   (2 mks)

To form K_2CO_3

5. Oxygen exists as diatomic molecules (½) / Simple Molecular

The forces of attraction between the molecules are very weak (½) therefore less energy is required to separate them. (½)

Atoms are sodium are held by strong metallic bonds (l). These require a lot of energy to break them (½)

6. 60

30^{E+21} wrong/ correct change (- ½)

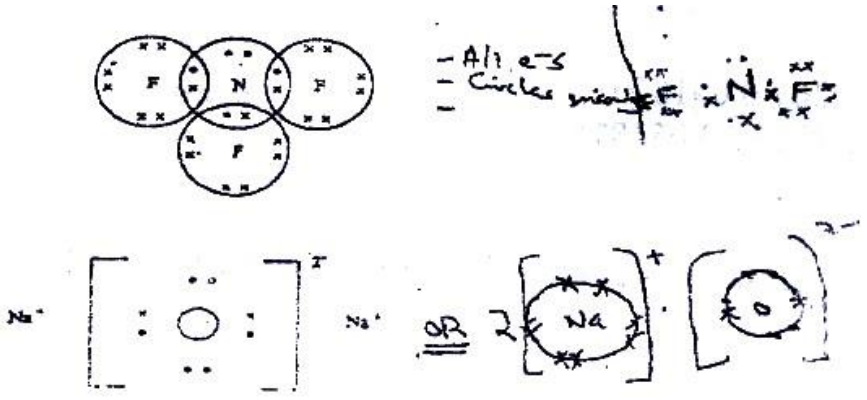
7. (a) $Al^{3+} + (l) + 3e^- \rightarrow AL (s) (l)$

(b) 27 g require 3 faradays (l)

1800 x 1000g requires $\frac{3 \times 1800 \times 1000}{27}$

$= 2 \times 10^5$ Faradays (½) = 200, 000 F (3 mks)

8.



9. (a) Heat change when one mole of a solute dissolve in excess of the solvent (l)

(i) $\Delta H_1 = +733$ kj Mol -1 Until no further Δ in temperature

ΔH_2 = 406 kJ mol -1 / Infinitely dilute solution

ΔH_3= 335 kJ mol -1

(ii) Molar heat of solution

Must be correct (733 – (+ 406 + 335 = 733 – 406 - 335)
= -8 kJ Mol -1 (3 mks)

10. At anode 40H (aq) → $2H_2O_{(l)} + O_2$ (g) + 4e

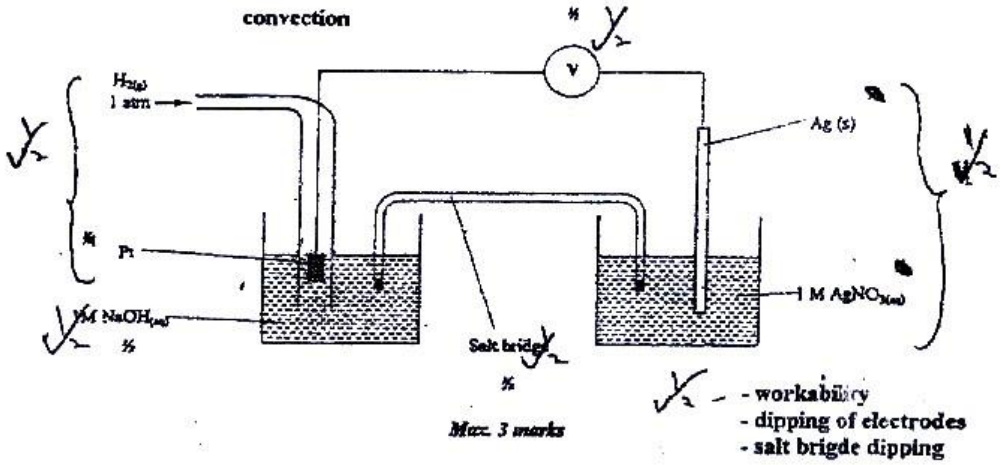
At cathode $2H^+$ (aq) + 2e→ H_2 (g) / $4N^+$ (aq) + $4e^+$ → 2 Hg

Or $4OH^-$(aq) + 4 H(aq) → 2 H_2O(l) + O_2 + (g) + 2 H_2 (g) (l)

11. To 50 cm^3 of 2.8 M NaOH, add 25 cm^3 of 2.8 M H_2SO_4 or 50 cm^3 of 1.4 M/ 100m^3 of 0.7 m

- Heat mixture to concentrate (½)
- Cool it for crystals to form (½)
- Filter and dry the residue (3 mks)

12.



13. Moles of oxygen = 0.83 = 0.026 (½) / 0.0259375

Moles of $NaNO_3$ = 2 x 0.026 / 0.051875

0.05 (½) / 0.051875

R. M .M $NaCO_3$ = 85 (½)

Mass of $NaNO_3$ = converted $\frac{0.052 \times 85}{4.41}$ / 4.4094 (½)

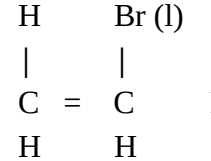
$\frac{4.41}{8.53}$

51. 693%5

Or 183

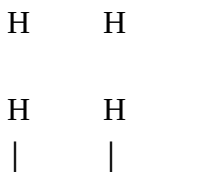
51.7% (3 mks)

14. (a)



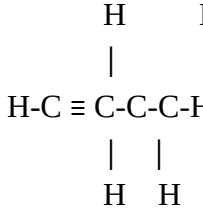
Bromoethane (l) / 1 bromoethane (2 mks)

(b)



(½) (1 mk)

(c)



(½) (1 mk)

15. (a) The gas burns with a blue flame (1)

(b) (i) The iron isles reactive than magnesium (1)

(ii) Heat the iron powder (1) (3 mks)

16. (a) To be read from graph (x) = 79g/ 100g water 78 + 1 g / 100g H_2O

(77, 78, 79)

(b) R.F.M of KNO_3 = 101

Molar concentration = $\frac{79\ ½}{101} \times \frac{1000/}{100}$

= 7.82 m

17. 10 electrons (l)

3 single bonds constitutes 6 electrons – There are 5 covalent bonds Double bond – 4 electrons (l) – 3 single bonds 1 double bond

18. Bottle Correct label

1	Sodium chloride
2	Sugar
3	Sodium carbonate (3 mks)

19. (a) Catalyst (l) or words to that effect

(b) Add bromine water or acidified potassium magnate (VII) (1) if they decolorize (½) then gas is either an alkene or an alkynes (½) (3 mks)

20. (a) Chemical change

(b) Physical change

(c) Chemical change

21. Magnesium phosphate (reject formula)

22. Tests 2 (½) and 3 (½) for test 2 iron is above hydrogen in the reactivity series hence it displaces hydrogen (i) for test 3. Dilute sulphuric acid is not an oxidizing agent (1).

23. (a) Pale green solution turns yellow (i)

(b) Sodium hydroxide (l) Potassium hydroxide

(c) Water (l)

24. (a) S_1H_4 it has a higher boiling point (l)

(b) No hydrogen bonding in CH_4 and S_1H_4 (l) while the hydrogen bond in H_2O is stronger than that in H_2S_1 (l)

25. (a) Colourless solution becomes brown/ black
L_2 (aq)/S

(b) Blue PPt dissolving to form a deep blue solution (l) $Cu(NH_3)_4^{2+}$ (3 mks) 26. (a) Temperature and pressure are directly proportional (l) IR words towards that

ofeal

(b) With increase in temperature, the gas particles gain more Kinetic energy (l)

They move faster and collide with the walls of the container more frequently hence increasing pressure.

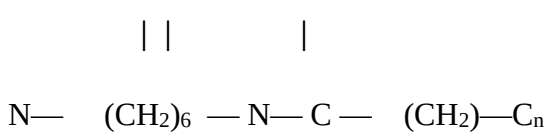
27. The amount of hydrogen would reduce (l) increase in pressure shifts the reaction to the side with fewer molecules or Equation shifts to the left.

Less Volume

28. (a) Energy of the activated energy (1) Therefore more molecules will take part

in effective collision. (3 mks)

29. (a)



(b) Making synthetic fibres such as for

- Ropes
- Blouses
- Stockings
- Undergarments
- Trousers

30. (a) Crush the roses with a suitable solvent (½) Filter/ decant/ Scape wilt, droper to obtain pigment/ e.g. ethanol – Methanol – Propanus - Aocome

(b) Add pigment to an acid or base

It shows different colours in each

K.C.S.E 2009 CHEMISTRY PAPER 2 MARKING SCHEME

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

(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 $= 0.0311 \times 3/2$

$= 0.047$

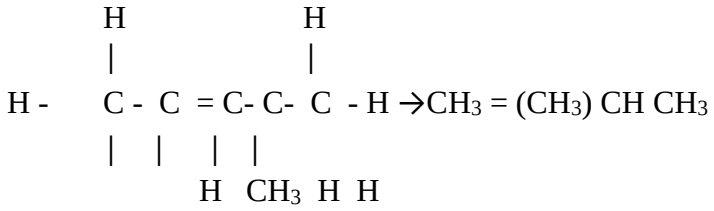
Vol of Cl_2 gas $= 0.047 \times 24$

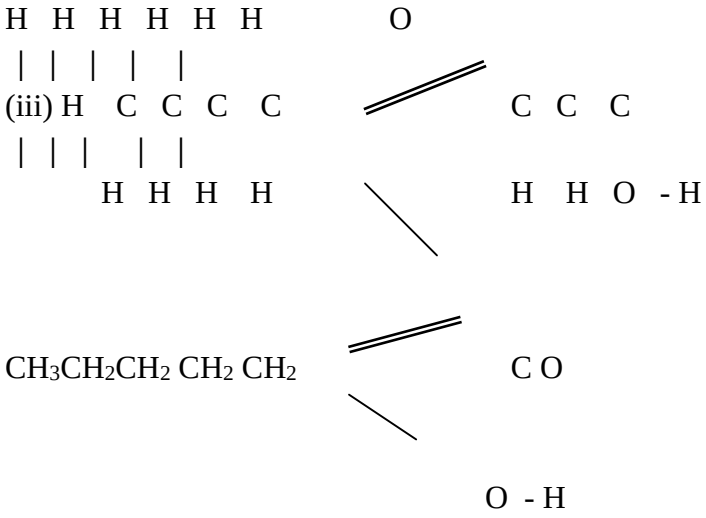
$= 1.12\ dm^3$

(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;





(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

$2.31 = \frac{2160 \times RAM}{2 \times 96500}$ = 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. $NH_4HCO_3(aq) + NaCl(aq) \rightarrow NaHCO_2(s) + NH_4Cl(aq)$

(iii)

1. Filtration
2. Heating

(iv) I. $NaCO_3(s) + H_2SO_4(aq) \rightarrow N_aSO_4(aq) + CO_2(g) + H_2O(l)$

Moles of $H_2SO_4 = \frac{40 \times 0.5}{1,000}$

$= 0.02$

Moles of Na_2CO_3 = Moles of $H_2SO_4 = 0.02$

Mass of $Na_2CO_3 = 0.02 \times 106$

2.12 (g)

Percentage purity $= \frac{(2.12 \times 100)}{2.15}$ %

$= 98.6\%$

II. Mass of $Na_2CO_3 = 0.02 \times 106$

$= 2.12$ 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.