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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 = $\frac{15}{100g}$ = 0.15Moles
   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

$\frac{3 \times 12}{58}$ x 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

(Accept any value 2870)Any calculation (1mk)

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

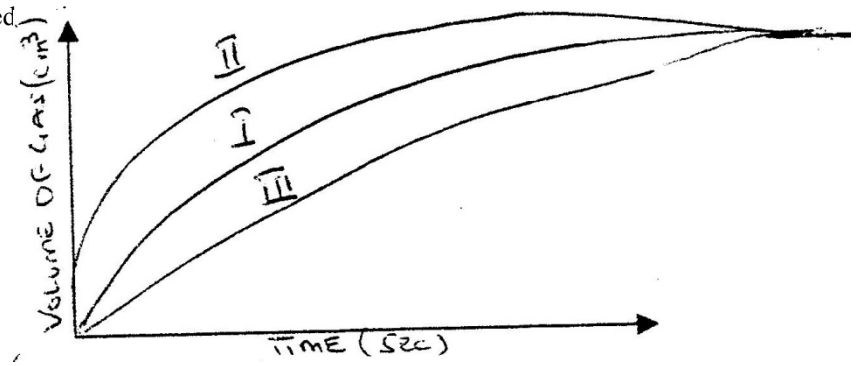
17. a) I – Molten sulphur

b) II – Superheated water / water.

18. a) 2HCl (aq) + Zncl □(aq) + H2 (g) ($^{-1}/_2$) states)

b) $2H_2$ (g) + O_2 (g ⟶ $2H_2O$ (g) (Not L) ($^{-1}/_2$ state)

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

20. 

21. W because its solubility decreases with increase in temperature

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)

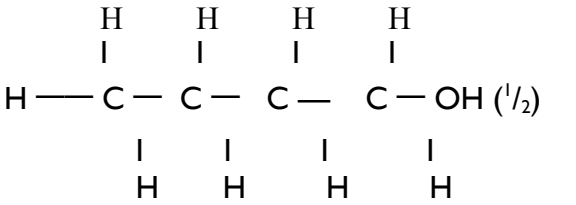
24. A gas with a smell of rotten eggs is formed H_2S gas is formed / A greenish solution is formed? Effervescence / A gas is produced / Black solid dissolves. (1mk)

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



Butan – 1 01 But – 2- 01
Butan-2-01($^1/_2$)
Butanol
But-01-01

b) $2CH_3\,CH_2\,CH_2\,OH_{(l)} + 2K_{(S)} \longrightarrow 2CH_3CH_2CH_2CH_2OK^+(l)+H_2(g)$
$2S_9H9OH + 2K \longrightarrow 2C_4H_9OK + H_2$ (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 ⟶ 50g if Pa ⟶ 25g Pa ⟶ 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)

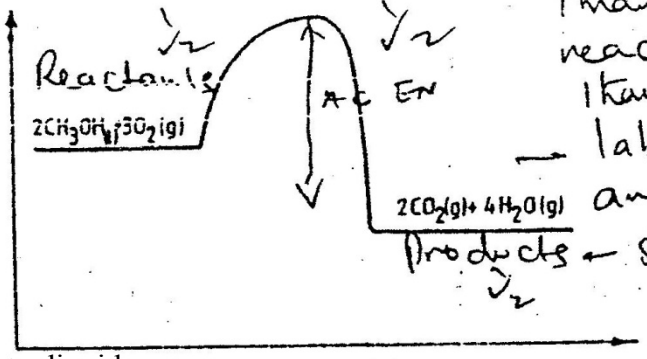
2. (a) (i) Liquid P – concentrated sulphuric acid (1 mk)
   Solid Q- Aluminium (III) chloride OR $AICI_3$ (1 mk)
   (ii) Anhydrous calcium chloride or fused calcium or lumps of calcium chloride (1 mk)
   (iii) The blue litmus paper turns red because the HCI(g) that does not react with the aluminum dissolves in the water making it acidic. (2mks)

   (b) (i) $NH_4 + HCI\ (g) \rightarrow NH_4\ CI(g)$ (1 mk)
   (ii) $HCI\ (g) + NH_4\ (g) \rightarrow NH_4CI\ (g)$ (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)
   $CH_3OH + 3O \rightarrow CO_2$ + Heat (penalize ½ if wrong unit for answers)
   (3 mks)

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

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

(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)

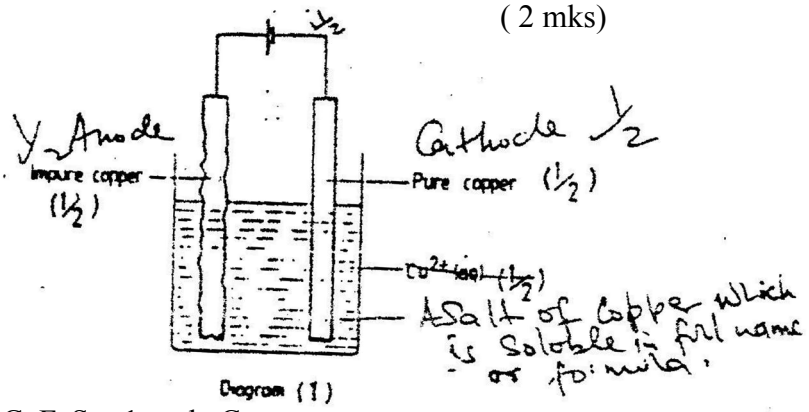


Diagram (1)

(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

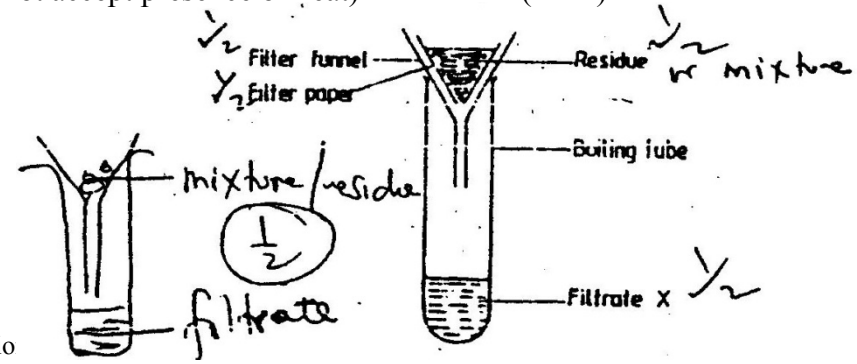
$CuFeS_2 = 63.5 + 56 + 64 = 183.5$ g

$= 183.5 \times 3.3 = 605.6 \times 10^3$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+} (aq) + $4NH^3$ (aq) → $[Zn(NH_3)^4$

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

(v) Addition of anhydrous or white $CuSo_4$ copper (II) sulphate which 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 – $\frac{320}{1/5} \times \frac{1/2 \times 3}{1} = 0.02$ 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

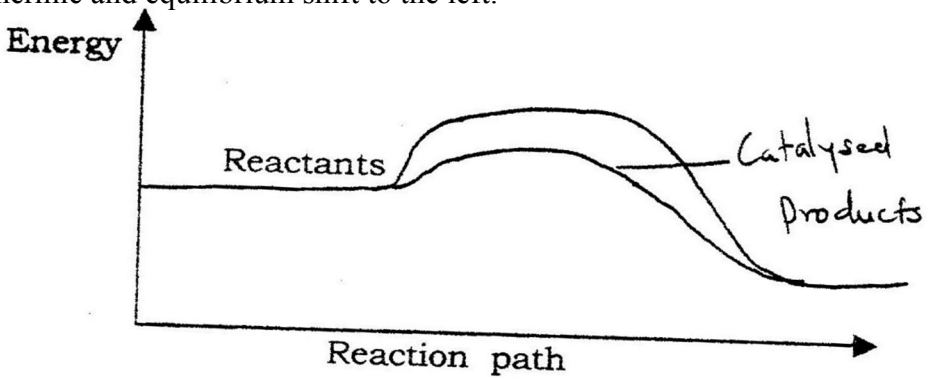
Holes of HCL = $\frac{100 \times 0.2}{1000}$ = 0.02

Nine was in excess

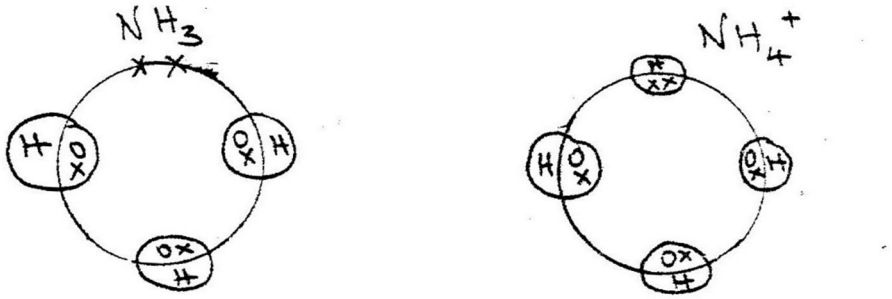
b) Moles of H_2 produced = 0.01

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.

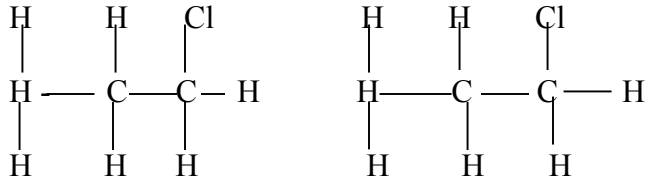


It has a lone pair of electrons which it uses to form a dative bond with H ions (1mk)

6. a) G
b) E

7. a) U-V Light/ sunlight

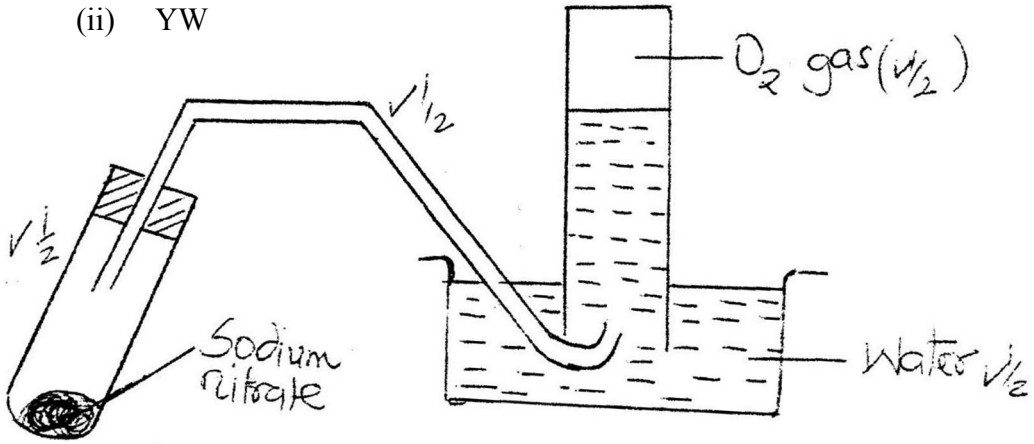
b)



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 $2mg_{(s)} + O_{2\,(g)} \longrightarrow MgO_{\,(s)}$
$3Mg_{(s)} + N_{2\,(g\ )} \longrightarrow Mg_3\,N_{2(s)}$

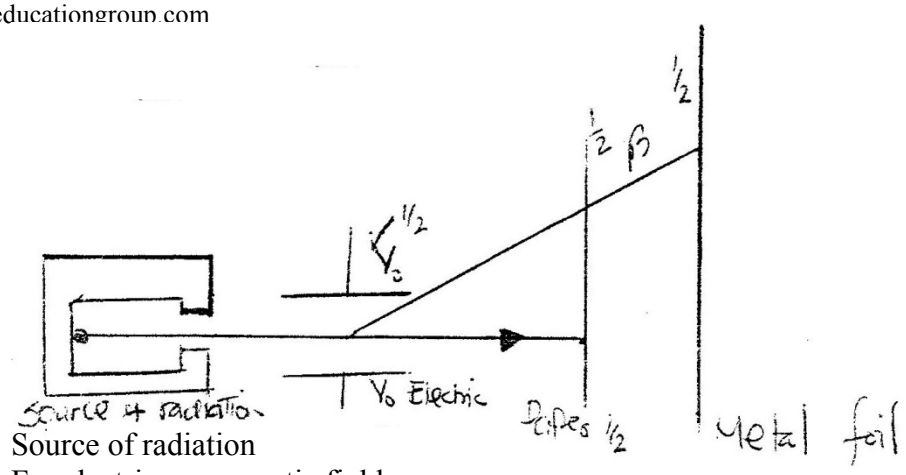
13. I, production of carbon dioxide or carbon is oxidized to its highest oxidation number/ carbon dioxide cannot burn further or carbon dioxide cannot burn further or carbon monoxide can burn further.
14. Increase in pressure would shift the equilibrium to the left; since in pressure favors the reaction 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 $P_2\,O_2$
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.



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 = 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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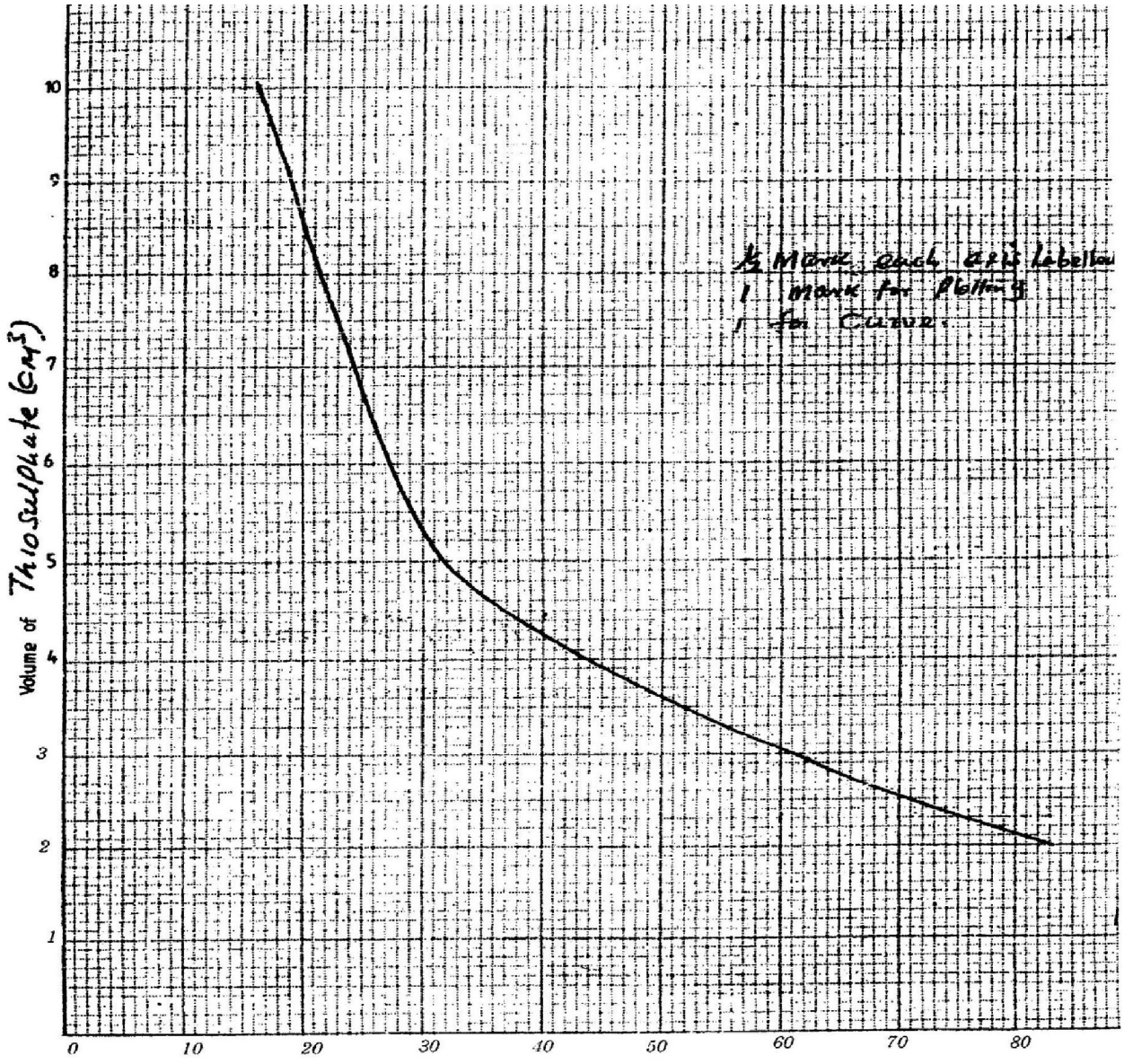
1. (a) i)



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)

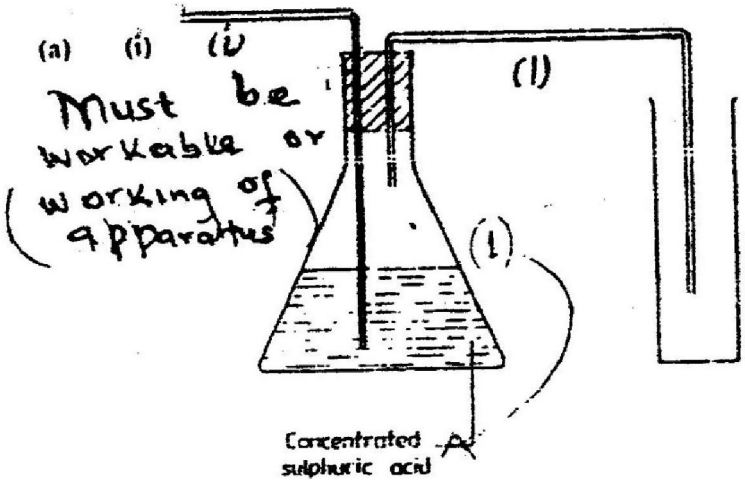
b) (i) I Moles of thiosulphate = $\frac{10}{1000}$ x 0.4 = 0.004 moles

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) $4OH^-_{(aq)} \longrightarrow O_2(g) + 2H_2O(l) + 4e$
OR
$4H^+_{(aq)} + 4e \longrightarrow H_2(g)$ s (1mk)

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

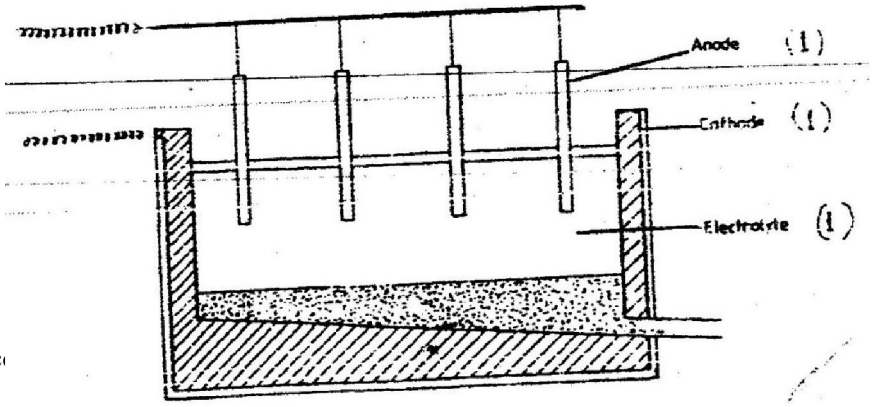
(ii) Water is a poor electrolyte when HCL gas dissolves in form hydrochloric acid which is an electrolyte. (2mks)

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

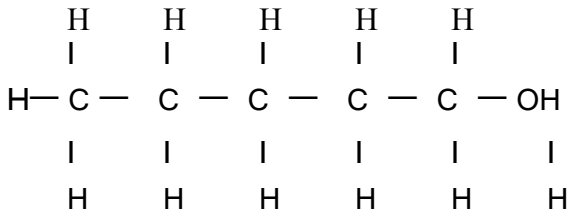
C) Quantity of electricity = 40,000 x 60 x60 coulombs.
3x96, 500 coulombs of produce 27g of Al
40,000x 60 x 60 x27
3x 96,500x 1,000
= 13.4kg.

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^{o}C)

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} $\frac{6.95 \times 1000}{278 \times 250}$

7. a) i) I) 18.8ºC (avoid 17.5ºC)

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

Maximum mass in 15 litres = 154 x 15g.

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

Moles of SO2 = $\frac{98}{64}$ = 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) $SO_3(g) + H_2SO_4 \longrightarrow$ H2S2O7(10)

III) $H_2S_2O_{7(l)} + H_2O_{(10} \longrightarrow 2H_2SO_{4(l)}$ or $_{(aq)}$

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.

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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, Artifi rubber, care tyres manufacture of plas
Polymhyl chloride Polychloethane polychoeroethane	Vinyl chloride (chloroethane)	Insulation of electric cables, plastics, p cups, pipes, making plastic tiles, plasti 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 = $\frac{100}{25} = 4$

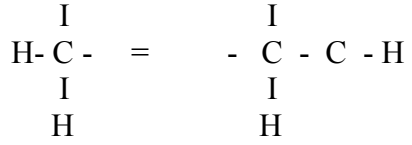
   $\frac{5}{M} = (^1/_2)^4 = M = 80g$

8. (a) $C_2H_3 = 27$

   $27n = 54$

   $n = 2$

   MF = $(C_2H_3)_2 = C_4H_6$



(c) Alkyne/ Alkene

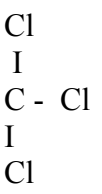
Depending on the structure

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

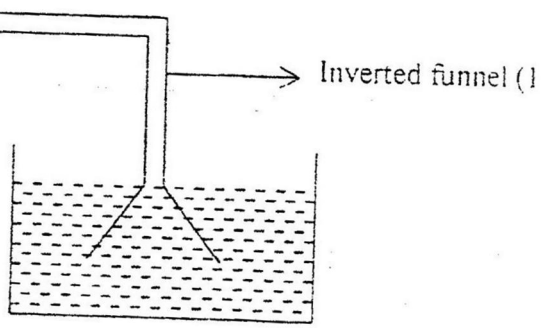
12. - Tetrachlomethane/ carbon tetrachloride



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 Cl_2 (g) are poisonous gases (They have irritating/ pungent smell)

15.



16. - $\frac{0.5 \times 100}{T_2} = \frac{4000}{500} \times 1$ T2 $= \frac{50 \times 500}{400} = 62.5K$

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

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

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

$T_2 = 62.5\ K$

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. $\Delta H = 500 \times 9 \times 4.2$

    $\Delta H = 18900J$

    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

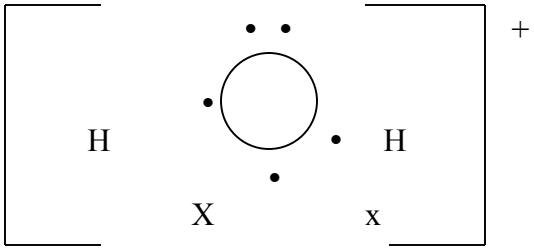
26. a) -pbO, ZnO, pbO_2, SnO,Sno_2,Al_2O_3

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

$NaAlO_2$, $NaSnO_2$

27. a) CO_2

b) H_3O+



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

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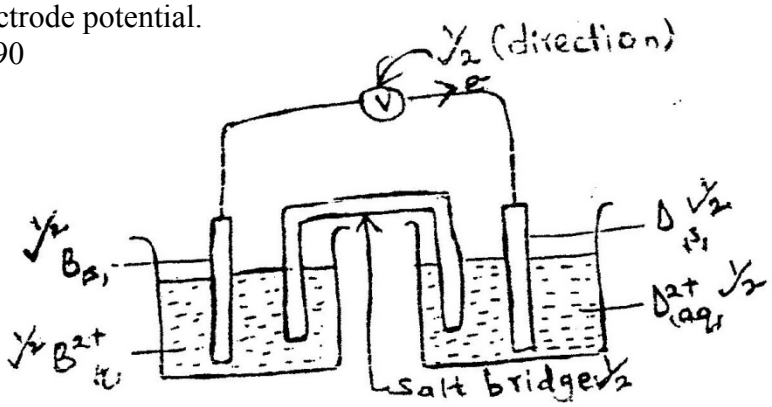
MARKING SCHEME.

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
= 3600 coulombs.
63.5g Cu requires 2x96500
3600 C produce $\frac{63.5 \times 3600}{2 \times 96500} = 1.18gm$

$\frac{0.2 \times 5 \times 60 \times 60 \times 63.5}{2 \times 96500}$

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.

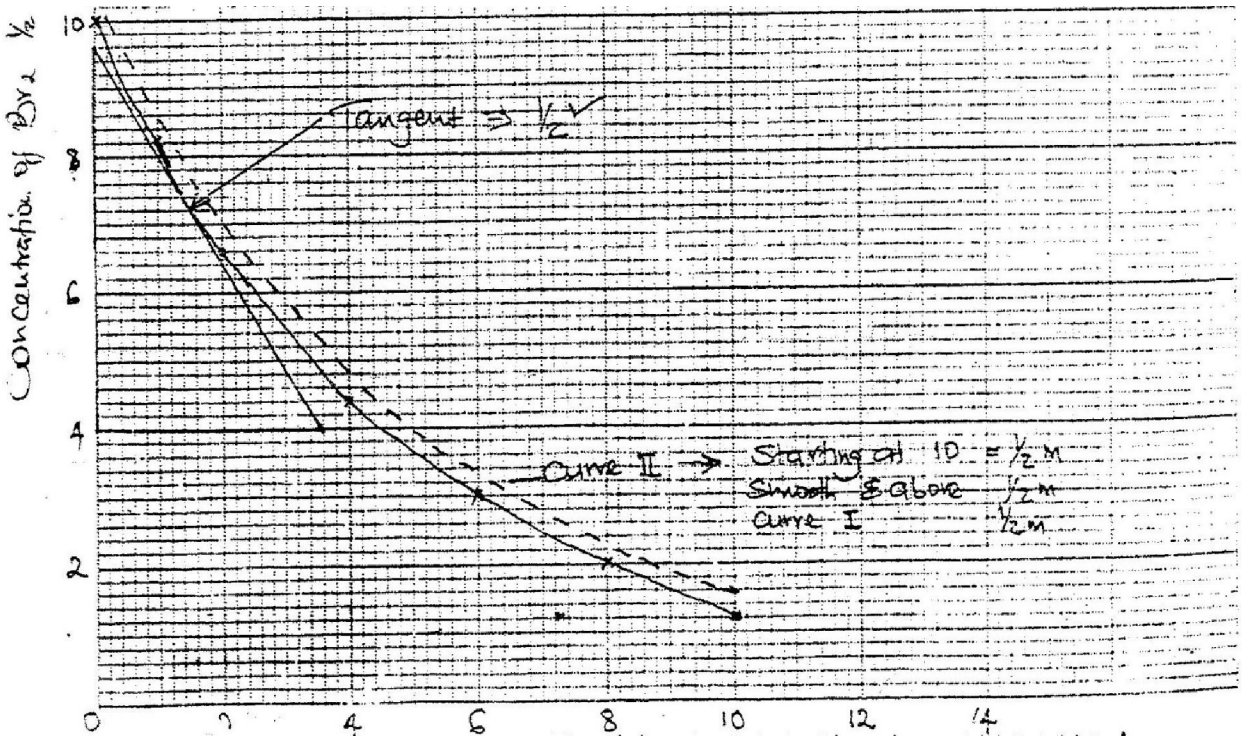
(v) I Cathode $Na^+ (l) + e^- \longrightarrow Na (l)$

II Anode $2Cl^- (l) \longrightarrow Cl_{2\,(g)} + 2e^-$

(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) $4Fe(s) + 3O2_{(g)}$

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

(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

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

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

(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

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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

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) $\vert$ Al(s) $\vert$ $Al^{3+}(aq)$ $\vert$ $Fe^{2+}(aq)$ $\vert$ Fe(s) $\vert$

   EMF $= E^{\theta}_{R}. E^{\theta}O$
   $= (-0.44) - (-1.66) = 1.22V$

   (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

   $C_xH_y + O_2 \rightarrow x\,CO_2 + {}^{y}/_{2}\,H_3O$

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

   3:52 $\quad$ 1:44

   r: $\frac{3.52}{44} = 0.08$ $\quad$ $\frac{1.44}{44} = 0.08$

   $= \frac{0.08}{0.08} = 1$ $\quad$ $\frac{0.08}{0.08} = 1$

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

   $=E.F = CH_2$ $\quad$ $y = 2$

   $E.F.M = 14$

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

   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

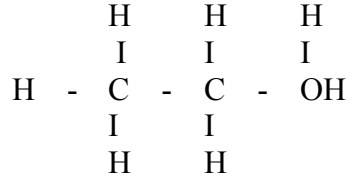
5. 16N
15P

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.

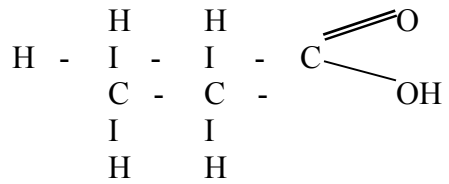
7. Strong acid - one which is fully dissociated when in water e.g HCI, Hi, Hi, HBr
Weak Acid: one which is partially dissociated when in water e.g. CH_3COOH

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



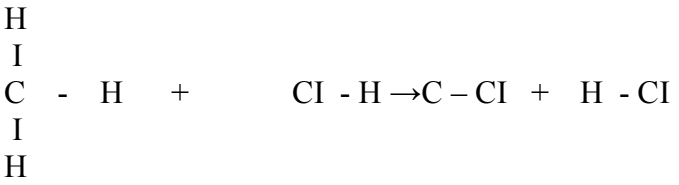
(b) Propanoic



(c) – Ethylpropanoate

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

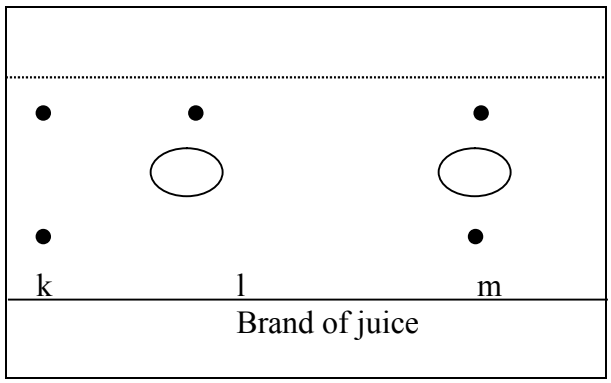
11. $CH_4(g) + CI_2(g) \rightarrow CH_3CI(g) + HCI(g)$



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

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

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

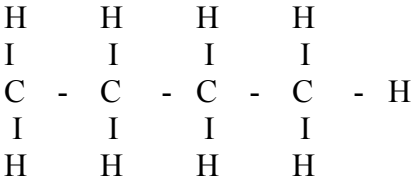
18. $P_1 + P_2$ Vol is constant
T_1
$\frac{760}{273} = \frac{P_2}{373}$ $P_2 = \frac{760 \times 373}{273} = 1038 \pm$ mmHg

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



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

CHEMISTRY PAPER 233/ 2 K.C.S.E – 1998
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) $C_3H_8(g) + 5O_2(g) \; 3CO_2(g) + 4H_2O(I)$

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) (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) $2P(s) + 3CI_2(g)$ $2 PCI_3(g)$ $P_4 + 6CI_2$ (g) $4 PCI_3(I)$
(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 $AgNO_3$
$= 241 \times 10^{-3}$

(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

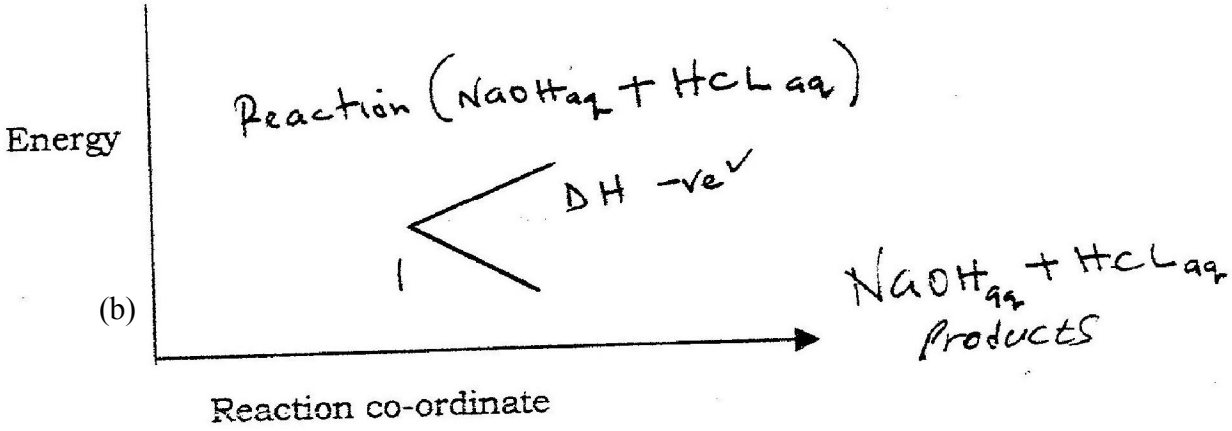
(iv) I.
$T=30.9 - 24.5 = 6.4^0C$
$H = 200 \times 6.4\ (I) \times 4.2 = 537$ joules

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

0.1 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)



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) $2S + U\ S_2U$

(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) $\mid$ Al(s) $\mid$ $Al^{3+}(aq)$ $\mid$ $Fe^{2+}(aq)$ $\mid$ Fe(s) $\mid$

   EMF $= E^{\theta}_{R}. E^{\theta}O$
   $= (-0.44) - (-1.66) = 1.22V$

   (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

   $C_xH_y + O_2 \; x\, CO_2 + {}^{y}/_{2}\, H_3O$

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

   3:52 $\quad$ 1:44

   r: $\frac{3.52}{45} = 0.08$ $\quad$ $\frac{1.44}{44} = 0.08$

   $= \frac{0.08}{0.09} = 1$ $\quad$ $\frac{0.08}{0.08} = 1$

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

   $=E.F = CH_2$ $\quad$ $y = 2$

   $E.F.M = 14$

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

   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 = 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. $FeCl_2$ 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

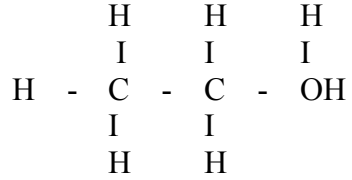
27. 16N
15P

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.

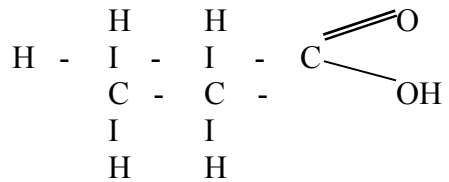
29. Strong acid - one which is fully dissociated when in water e.g HCI, Hi, Hi, HBr
Weak Acid: one which is partially dissociated when in water e.g. CH_3COOH

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



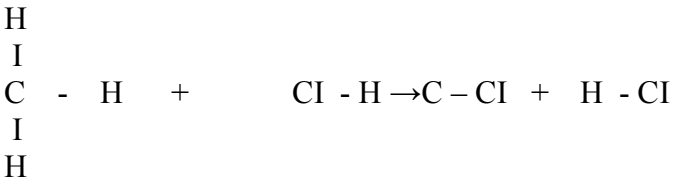
(b) Propanoic



(c) – Ethylpropanoate

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

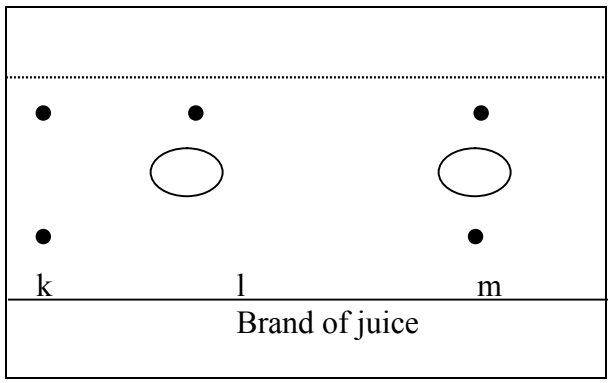
33. $CH_4(g) + CI_2(g) \rightarrow CH_3CI(g) + HCI(g)$



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

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: $\frac{680000g}{17}$ = 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) $Zn(NH_3)_4^{2+}$

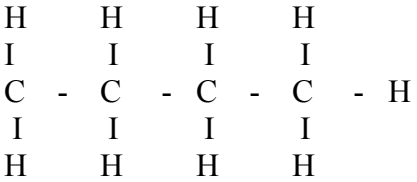
40. $P_1 + P_2$ Vol is constant
T_1
$\frac{760}{273} = \frac{P_2}{373}$ $P_2 = \frac{760 \times 373}{273} = 1038 \pm$ mmHg

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



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

CHEMISTRY PAPER 233/ 2 K.C.S.E – 1998
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)
   $\frac{168}{52} = 0.03$ $\frac{0.64}{16} = 0.04$
   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

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

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) (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) 2 PCI_3(g) $P_4 + 6CI_2$ (g) 4 PCI_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 $AgNO_3 = \frac{0.1 \times 24.1}{1000} = 2.41 \times 10^{-3}$

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

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2.41×10^{-2}

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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

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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$T=30.9 - 24.5 = 6.4^0C$
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II. moles of NaOH $= \frac{100 \times 1}{1000} = 0.1$ moles

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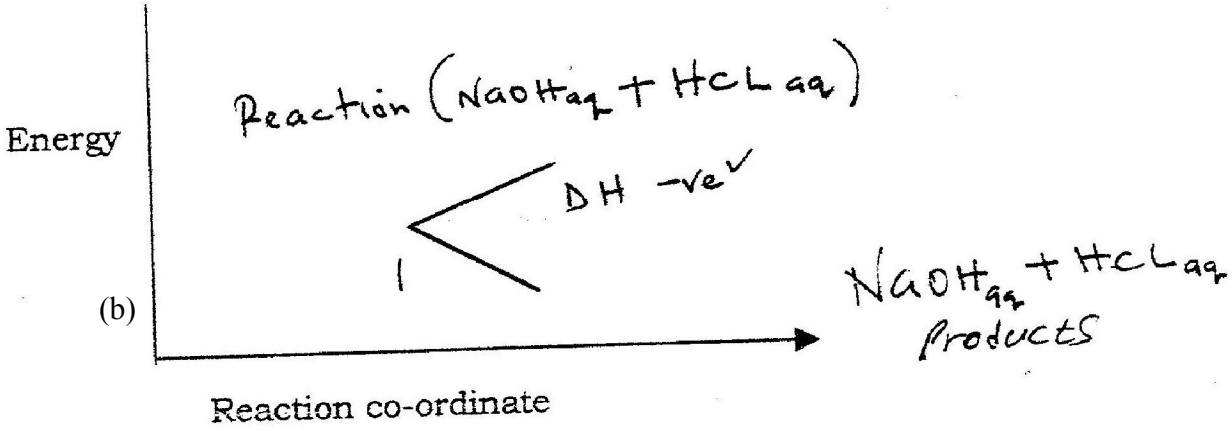
therefore 1 mole $= \frac{5376}{0.1 \times 1000}$
$= 53.76$ Kj mol^{-1}

(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)

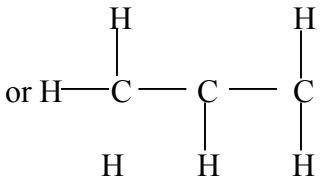
(ii) Anode
Oxygen (I)

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)

   CH_3CHCH_2 or 

   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 Alt. 2

Molarity of NaOH = 4 = 0.1M $H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + H_2O(l)$

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

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

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

moles of H_2SO_4 = 0.001

8cm3 = 0.001

1000cm3=?

= 0.1235M

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

= 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) $Mg(s) + H2O(g) \longrightarrow MgO(s) + H_2(g)$

$Mg(s) + 2H2O(l) \longrightarrow Mg(OH)2(s) + H_2(g)$

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 = 92sec ($^1/_2$)

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.

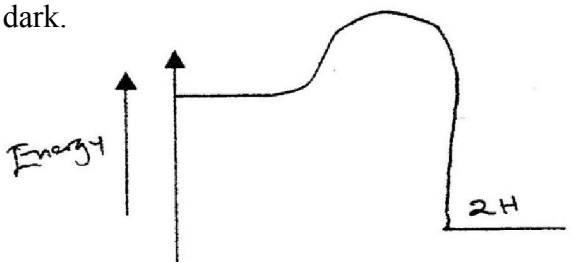
21. Acet5ylene (ethyne) or Hydrogen

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.



24.a)

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

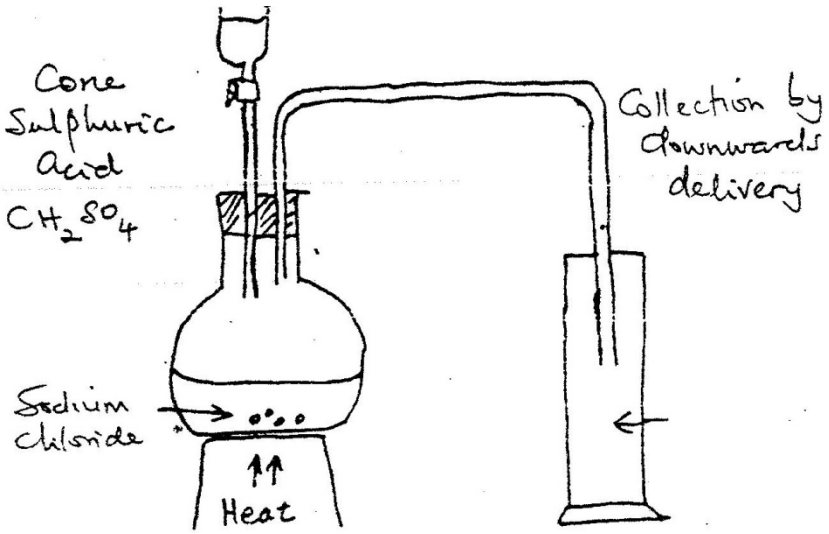
b) i) I. 2NaHg + 2h2O(l) 2NaOH(aq)+2Hg + H2(l) or
2 Na/hg + 2H2O(l) 2NaqOH + Hg + h2(g)
ii) Q = It = 100x5x60x60 = 1800000C
1 Faraday forms 1 mole of Na
1 mole of NA /Hg = 1 mole of NaOh
NaOH = 23 + 16+ 1= 40
96,500 40g of NaOH.
1800000C 40 x 1800000
96500
=746.1g

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

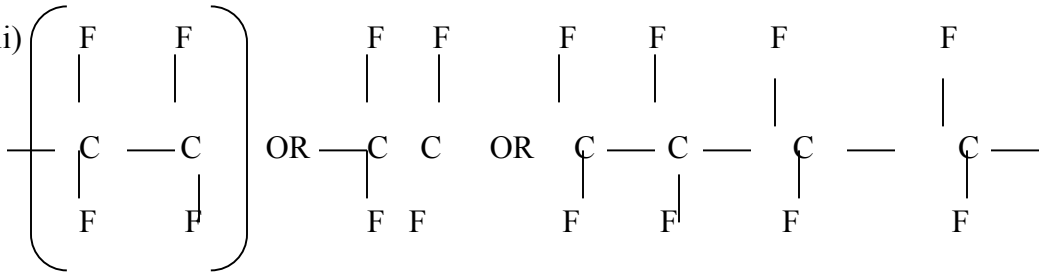
5. (a) (i) Pent -2 –ene
(ii) Butanoic acid

(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}

CHEMISTRY PAPER 233/1 K.C.S.E 2001
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

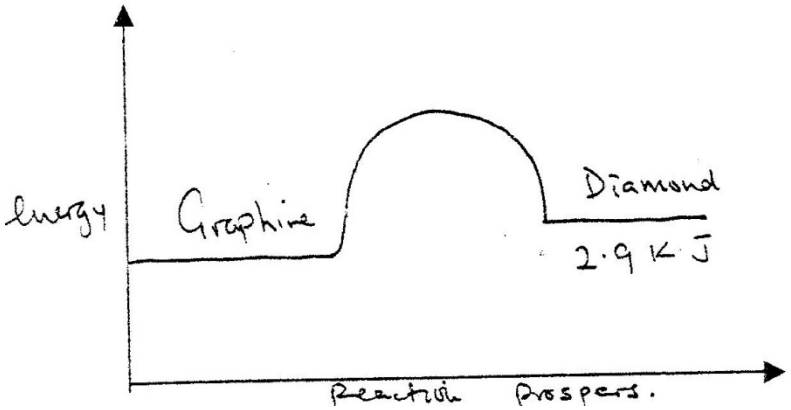
(b) D ‖ Argon ‖ 2.8.8.2

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

$16 + 18 = 100\%$

$106 + \frac{18n}{18n} = \frac{14.5}{100}$

$18n \times (-100) = 14.5\ (106 + 18n)$

$1800n = 1537 + 261n$
$1539n = 1537$
$1537 = 09987$
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

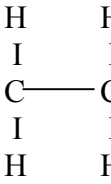
15. (a) Hygroscopy
(b) Drying of gases ‖ drying agent

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)



or. CH_3CH_2Cl Chloroethane ‖ Ethylchloride

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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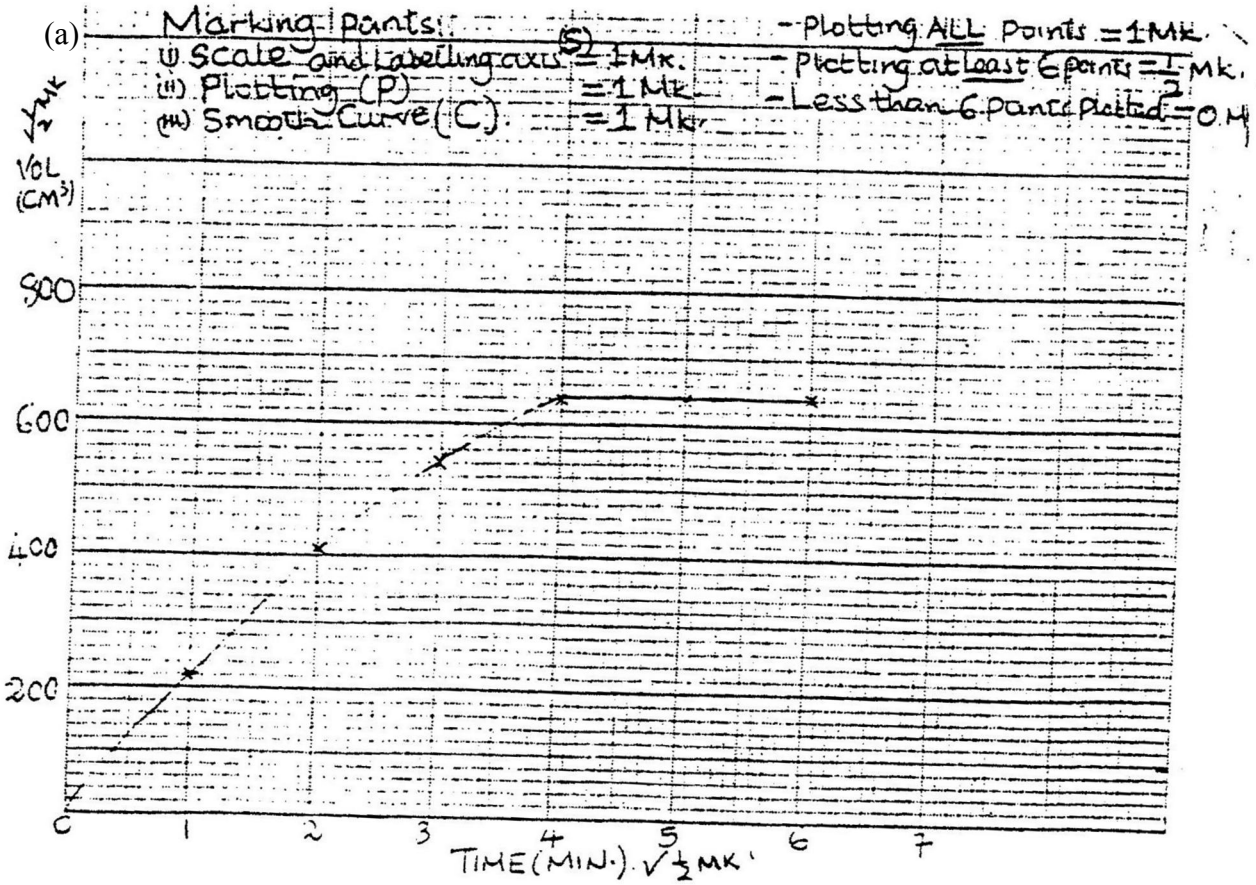
MARKING SCHEME

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) = $637.5 \times \frac{2}{24000} \times \frac{1}{3}$ 1 mk
- % Mass of AL = $\frac{0.478}{0.5} \times 100$ 2
(Range 95.55 – 95.64%)

(e) *- It is stronger than pure aluminium (1 mk)*

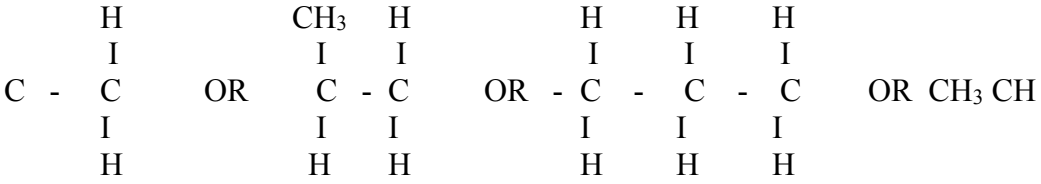
- It is harder than aluminium (1 mk)
- It is not easily corroded/ rusting (1 mk)
- It is more durable / higher ensile strength (1 mk)
(-Any correct two = 2 mks)

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) $2CH_3CH_2CH_2OH(I) + 2K(I) \rightarrow 2CH_3CH_2CH_2OK(s) + H_2(g)$
(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) $4OH(aq) \rightarrow 2(g) + 2H_2O(I) + 4e^-$
(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^oC, Oxygen = -183^oC)

- 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) $CaO(s) + H_2O(g) \rightarrow Ca(OHO_2$ 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 = 0.0045×24000
$= 110.76cm^3 - 111cm^3$
Alternative method
$2Fe(s) + 3Cl_2(g)\ 2FeCl_3(s)$
$3 \times 24000 \times 05 = 3$
162.5×2
$= 110.76cm^3 > 111cm^3$

(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: $Cl_2(g) + H_2O(l) \rightarrow HOCl(aq) + HCl(aq)$; then
$HOCl(aq) + Dye \rightarrow Dye(o) + HCl$

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) $2q\ (s) + 2H_2O(L) \rightarrow 2QOH\ (aq) + H_2\ (g)$
$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

(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) $^{210}_{81}J \rightarrow {}^{210}_{82}k + {}^{e}_{-1}$
    (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 = 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 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) → $ZnCO_3$(s)(l) (3 mks)

CHEMISTRY PAPER 233/2 K.C.S.E 2002
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)

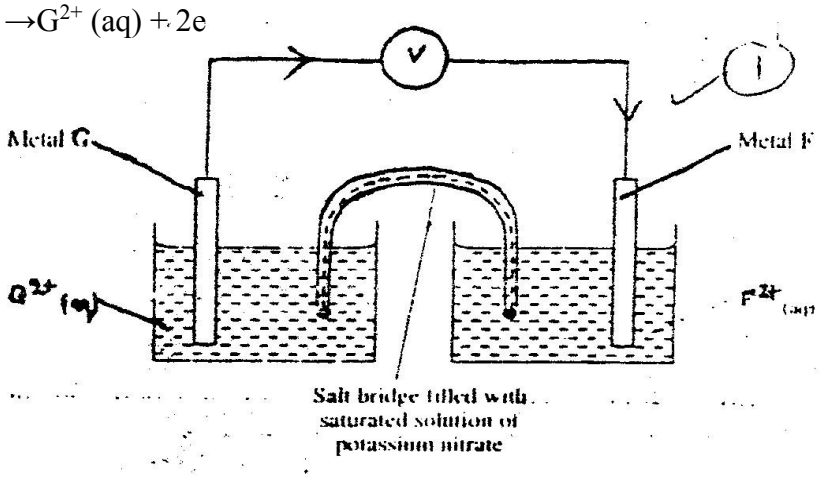
F

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

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

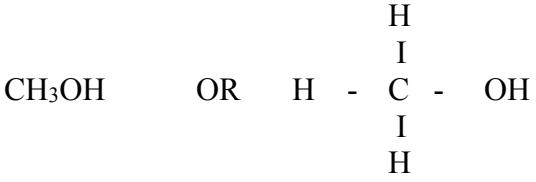
(ii) $CuCO_3(s) \rightarrow CuO(s) + CO_2$
Step 4
- Green solid dissolves to form blue solution
- There is effervescence // bubbles

Step 7
- Black solid dissolves to form a blue solution

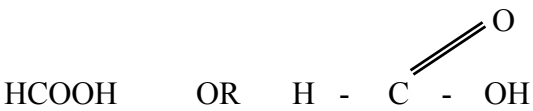
(c) (i) Tin // Sn

(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)



(ii) Methanoic acid (1 mk)



(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)

$C_6H_{12} + H_2 = C_6H_{14}$ 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

CHEMISTRY PAPER 233/1 K.C.S.E 2003
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. $2Al_{(s)} + 3/2\ O2 \longrightarrow Al2O3,\ \triangle H = -1673.6\ Kjmol^{-1}$(i)
   $Fe_2O_3 + Fe_2O_{3(s)} \longrightarrow 2Fe + 3/2\ O_2, \triangle H = 836.8KJ\ mol -$

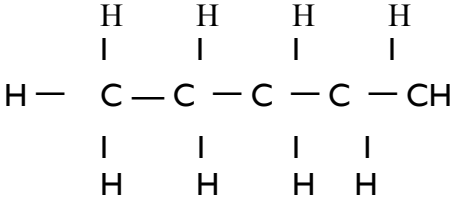
4. a) Rhombic ⟶ Octahedral Or Monoclinic – B – Prismatic
   b) - Vulcanisation
      - Manufacture of sulphuric acid / So2
      - Gun powder
      - Preparation of Ca(HSO3)2
      - Drugs
      - Fungicides
      - Match sticks head
5. $H \longrightarrow H^+ + e\ (^1/_2)\ \triangle H$ is +ve $(^1/_2)$
   $H + e \longrightarrow H^-\ (^1/_2)\quad \triangle H$ is –ve $(^1/_2)$
6. $Na2SO3(s) + 2\ HCl\ (aq) \longrightarrow 2NaCl\ (aq) + SO2\ (g) + H2O(l)$
   Moles of So2 = 160 / 2400 =0.04
   Moles ratio 1:1
   Moles of NaSo3 = 0.04
   Mass of NaSO3
   0.04 x 126
   =5.04 gm
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) $3mg\ (S) + N_2\ (g) \longrightarrow Mg_3N_2(S)$
    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) $2C_4H_9OH\ (l) + 2k\ (s) \qquad 2C_4H_9OK(s) + H_2(g)$
    $C_4H_9OH_9(l) + K(s) \qquad C_4H_9OK(s) + {}^1/_2\ H_2(g)$
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 1.48gm = 1.48x2x 96500

1gm = 2x96500 63.5

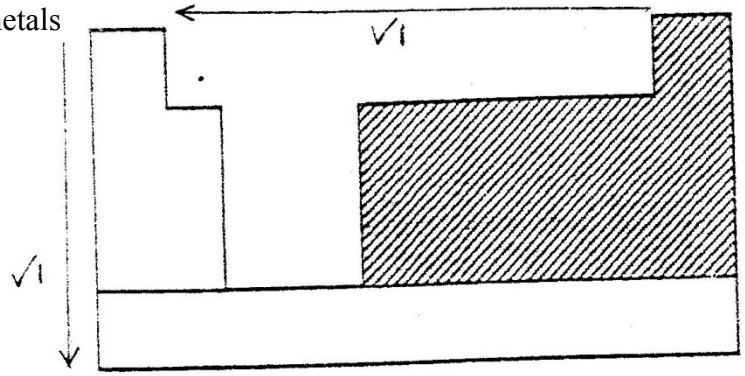
1x2.5x60x60x60x1 = 1.48x2x96500 q = 2.5 x 60 x 1

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

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

$= 0.5x2 \times 60 \times 60$

$= 3600$

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) $\frac{-2.95}{} = 0.125$ 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

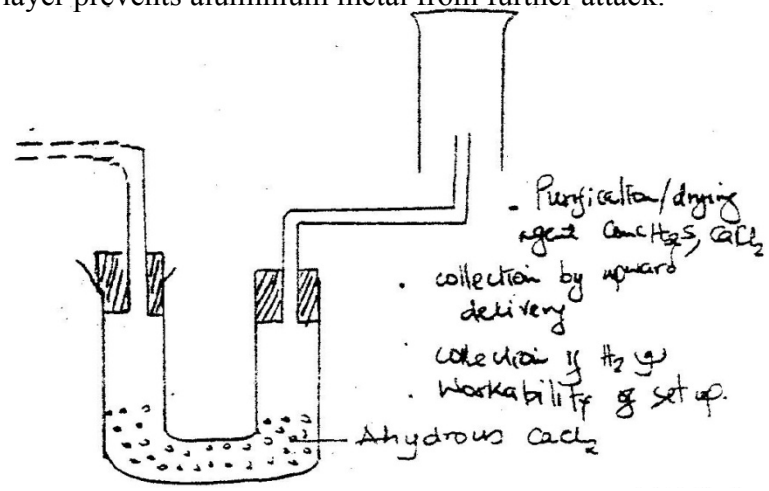
ii) Add hot cone. NaoH /KOH2, silca and AlO3 dissolves. Filter iron(iii) oxide. Bubble CO2 through filtrate/ add water/ add Al(OH)3 to precipitate. Al(OH)3. Filter al (OH)3 / silca remain in solution.

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.

6. a)



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

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

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

Moles of Zn = 0.05

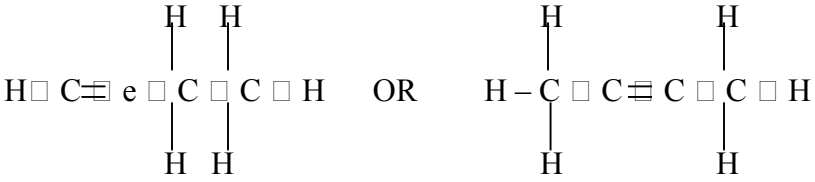
0.05 moles of zn = 0.05 moles

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

(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

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

   = 1.68570+
   = 1.7 1.6857 or 1.7

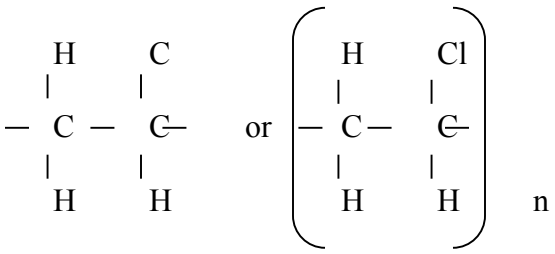
6. In diamond each carbon atom is covalently bonded to four other carbon atoms in a rigid giant atomic structure (1)
   In graphite each carbon atom is covalently bonded to three other carbon atoms in layers(i)
   The layers are held together by weak van der walls forces which are broken quite easily (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) $Mg2+_{(aq)} + CO_3^{2}{}_{(aq)} \longrightarrow MgCO_{3(s)}$ (1) penalize ½ more for missing state symbols

    b) RFM of $MgCO_3$ = 24 + 12 + 48 =84 (½)
    = 24 + 12 + 16 x 3 (½)

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

    $\frac{xx0.5}{1000} = 0.1$ (½)

    $X = \frac{1000x0.1}{0.5}$

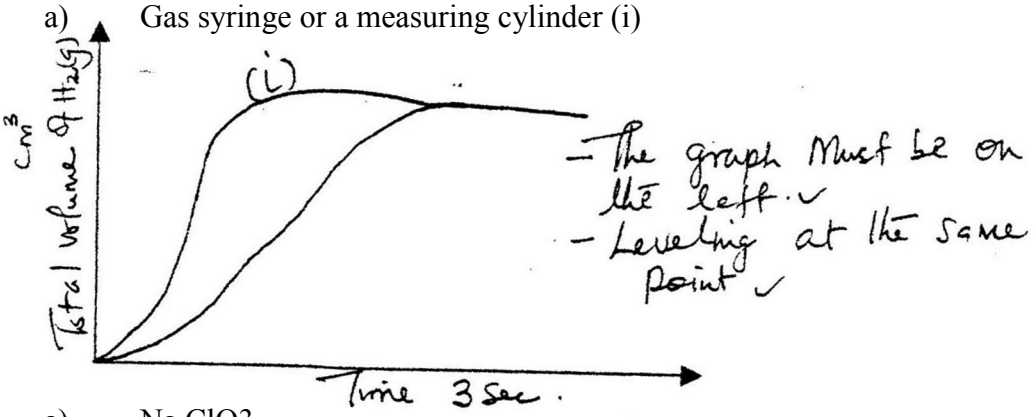
    c) = Test tube 1: There is effervescence (½) bubbler/ dissolved
    Test tube 2: No effervescence (½) no observable change/dissolved
    Ethanoic acid ionizes in water (1)
    H reacts with CO_3^{2-} to form CO_2 (l)

    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)



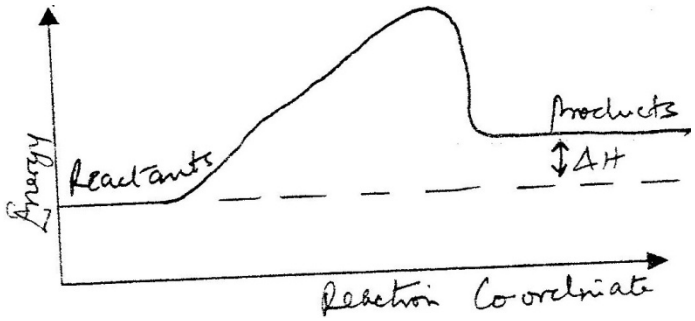
22. a) Na ClO3
Showing oxidation state of Cl in NaClO3
Showing Oxidation state of Cl in NaCl(1)
Oxidation involves loss of electrons (½)
To product is NaclO3 (½) increase in oxidation no from 0 to 5
NaClO3 oxidates state or +5

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) $pb^{2+}{}_{(aq)} + CO_{3(aq)} \rightarrow pbCO_{3(s)}$ (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

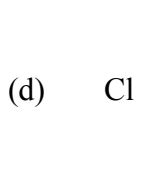
$2FeCl_2(aq) + Cl_2(g) \rightarrow 2FeCl_3(s)$

$\frac{6.30 \times 2400}{254}$

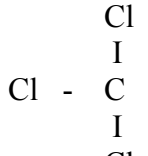
= 595. 2 cm^3

$\frac{8.06 \times 24000}{325}$
= 595.2 cm^3

Structure

(d)


Name 1,2 dichloroethane (rej) Dichloroethene)



(accept Hexachloroethane)

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^- are 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

$SO_3(g) + H_2 SO_4 (l) \rightarrow H_2S_2O_7$ (l

$H_2S_2O_7 (l) + H_2 O(l) \rightarrow 2H_2SO_4(l)$

(c) Formation of acid rain
It is poisonous / Harmful

(d) (i) $2NH_3(g) + H_2S)_4 (l) \rightarrow (NH_4)_2 SO_4(s)$

(ii) $2NH_3 (g) + H_2 SO_4 \rightarrow (NH_4)_2 SO_4 (s)$
R.m.m of $H_2SO_4 = 98$
R.m.m of $(NH_4)_2 SO_4 = 132$
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 $PbP_{(s)} + H_2(g) \rightarrow Pb_{(s)} + H_2O_{(l)}(g)$

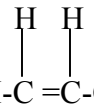
(b) (i) Cheap, corrosion resistant/ durable/ lead is poisonous/ Flexible
(ii) Lead is poisonous/ harmful

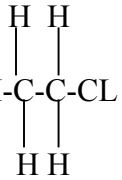
(c) (i) The reaction produces insoluble lead (II) sulphate which coats the surface of $Pb(NO_3)_2$ preventing further constant (mention of lead nitrate is a must.)
(ii) KNO_3 / $NaNO_3$

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.

a) P1 CH2CHCL // 

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	H2(g)
II	Anode	2Cl-(aq)	Cl2(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

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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)

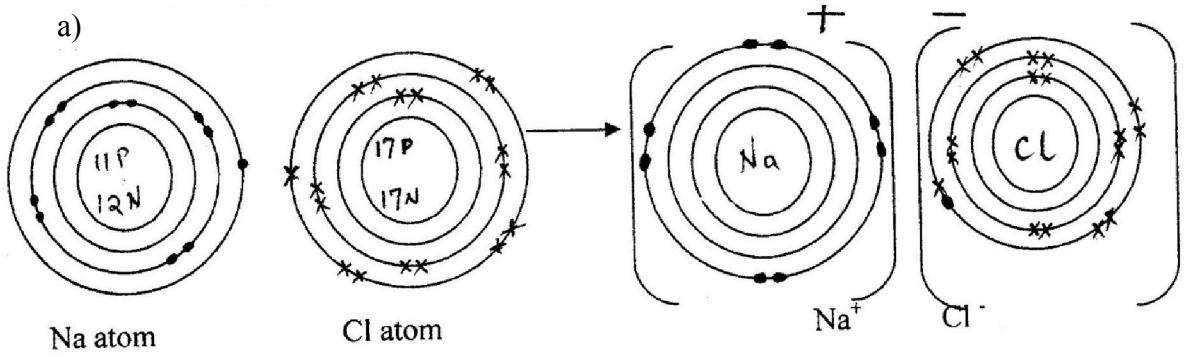
2. Hydrogen chloride reacts with calcium oxide in the presence of water to form calcium chloride.
$CaO(s) + 2HCl(g) \rightarrow CaCl_2(aq) + H_2O(l)$ (2mks)

3. (a) Carbon dioxide gas
(b) Temporary hard water dissolves hydrogen carbon salts which decomposes on heating to produce carbon dioxide

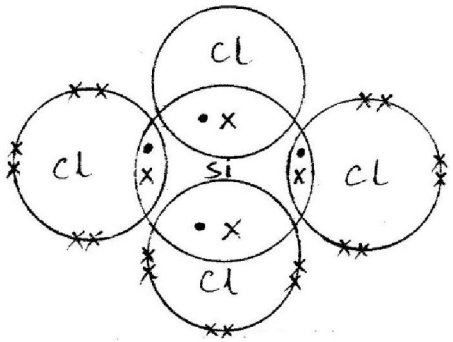
$$Ca(HCO_3)_2(aq) \xrightarrow{Heat} CaO_3(s) + H_2O(l) + CO_2(g)$$

4. Si = 2:8:4 Na = 2:8:1 and Cl = 2:8:7

a)



b)



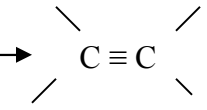
Silicon (IV) Tetra Chloride

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

Cl H

7. $H\text{-}C \equiv C\text{-}H + C12 \longrightarrow$ 

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 = $\frac{52 \times 14760}{}$ =

x 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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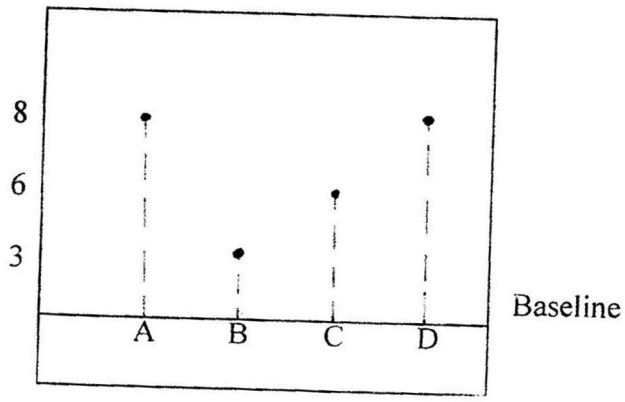
MARKING SCHEME PAPER 2

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)

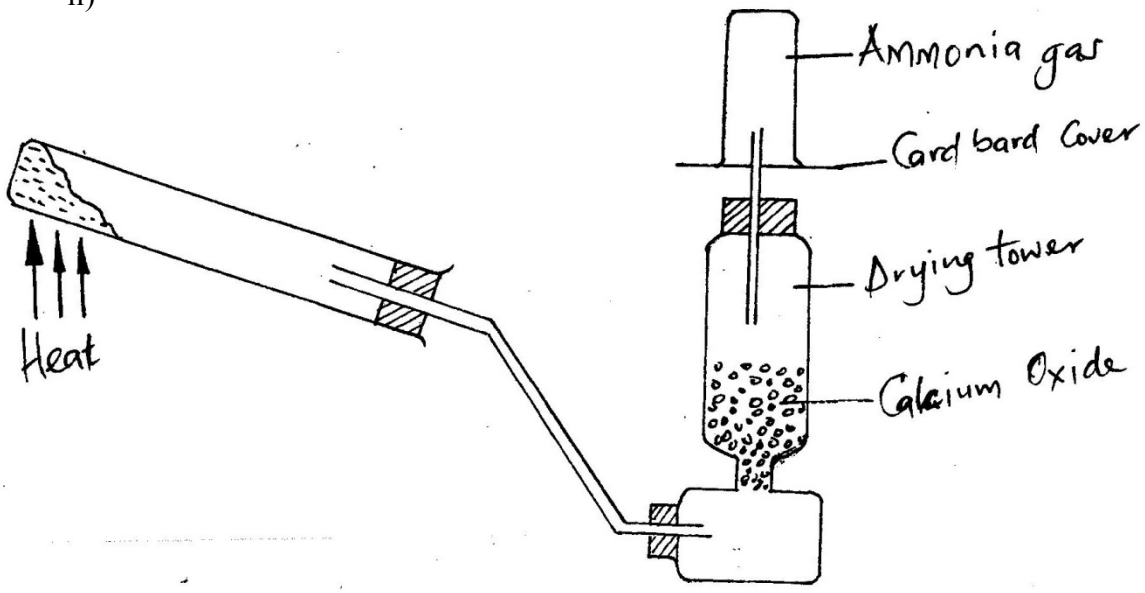
b) i) $2NaOH_{(aq)} + H_2SO_4\ 9_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$
2 Mol 1 Mol

ii) No. of moles of H_2SO_4 used = $\frac{40}{1000}$ x 0.5 moles
= 0.02 moles
No. of moles of NaOH = 0.02 x 2
= 0.04 moles

0.5 x 2 mole = 1.0 moles will react with 1 litre of the solution of the acid
100 cm^3 = 0.04 moles of NaOH
1000 cm^2 = $\frac{0.04 \times 1000}{100}$ = 0.4 moles
Molar mass of NaOH = 23 +16 +1
= 40
1 mole = 40
0.4 moles = 0.4 x 40
= 16g
Mass of the unreacted = 17.6 – 16
= 1.6g

c) i) M is ammonium chloride

ii)



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

ii) Ammonia acts a reducing agent.

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

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

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

iii) $E_o - E_R = \quad + 0.34 - (-0.44)$

$= \quad 0.34 + 0.44 = 0.78$ Volts

b) i) H

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

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

c) 144750 Coulombs = $\frac{144750 \text{ Faraday}}{96500}$

= 1.5 Faraday

2 Faraday yield = 64 g of copper

1.5 Faradays = 48 g copper

4. a) The number 52 represents mass number i.e.: the sum of the number of protons and neutrons in an atom of an element.

N = 20 = 2: 8: 8 : 2 p = 17 = 2:8:7

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

ii) P,R and S

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

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

iv) p and u

C) i) I – ionic II – Metallic

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

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

b) A white solid formed which is magnesium oxide

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

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

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 le detergents	Forms a scum with water contai calcium and magnesium ions
$R - SO_3 - Na^+$	They do not form sc with Ca^{2+} and Mg^{2+}	They are made from petroleum products or vegetable oils whicl expensive.

(c) (i) Easters

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

(iii) Used as solvents
In the manufacture of drugs and chemicals
In flavouring and preservation of food
In manufacture of synthetic fibres

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

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

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

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

(ii) A steel diaphragm is suspended between the electrodes

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

(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.

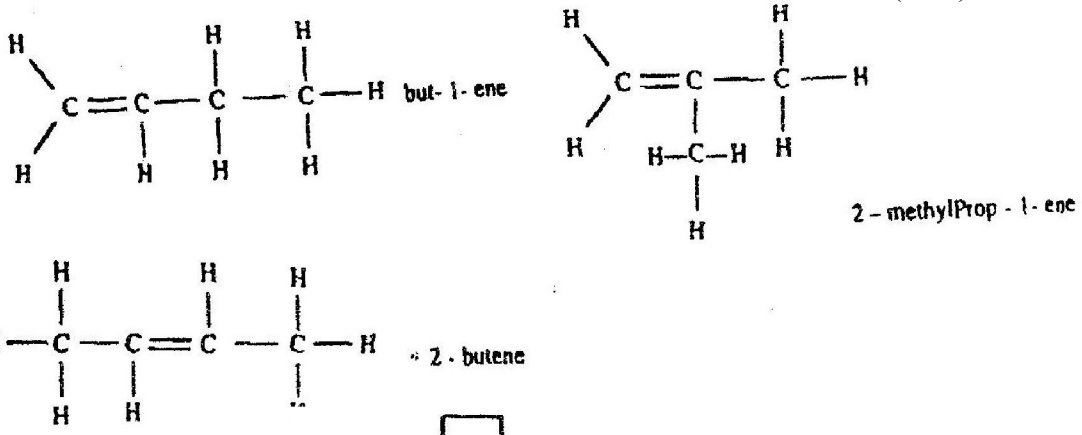
(d) $2Na(s) + O_2(g) \xrightarrow{\text{Limited}} Na_2O_2(s)$

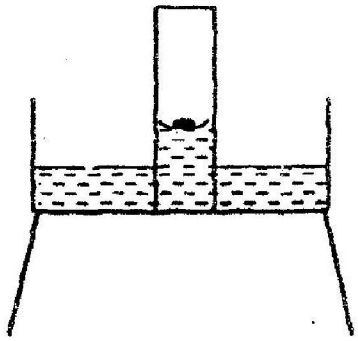
$Na(s) + O_2(g) \xrightarrow{\text{Excess}} Na_2O$

(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 a) 

b) Calibrate athe gas jar before the start of experiment (1mk)

3. $\frac{\text{Time for } SO_2}{\text{Time for } O_2} = \sqrt{\frac{R.M.M SO_2}{R.M.M O_2}}$

R.M.M of SO_2 =64
R.M.M of SO_2 = 32

$\frac{\text{Time for } SO_2}{50} = \sqrt{\frac{64}{32}}$

Time for SO2 = 70.7 seconds (3marks)

4 a) $37 + 0 \rightarrow 37$
$18^A - 1^e \quad 17^B$

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

$$\frac{51.3}{171} \quad \frac{43.2}{18} = 8$$

$$0.3 = 1 \quad \frac{2.4}{0.3} \quad 8$$
$$0.3$$

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) $4\ NH_{3(g)} + 5O_{2\ (g)} \quad 4\ NO_{(g)} + H_2O$ (1mk)

c) Fertilizers
Explosives (1mk)

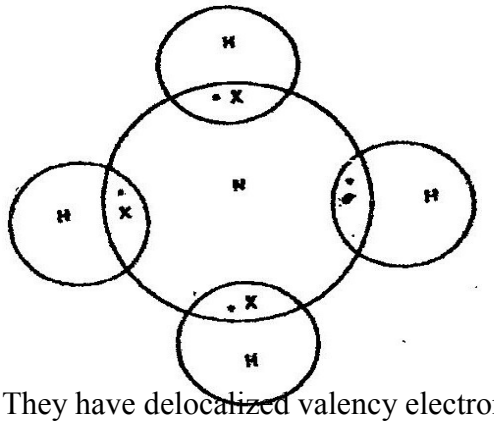
18. add anhydrous copper(II) Sulphate to substance S. It changes from white to blye
OR
Dip cobalt chloride paper into Substance s. It changes from blue to pink. (2mks)

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 (2mks)

b)



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) $\triangle H_1$ = Lattice energy
$\triangle H_2$ =Hydration energy (2mks)
b) $\triangle H_3 = \triangle H_2$ (1mk)

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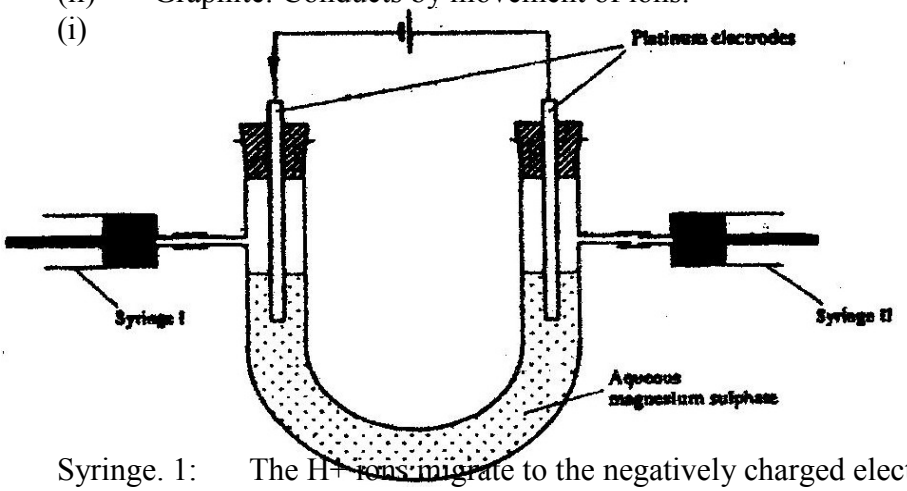
MARKING SCHEME

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

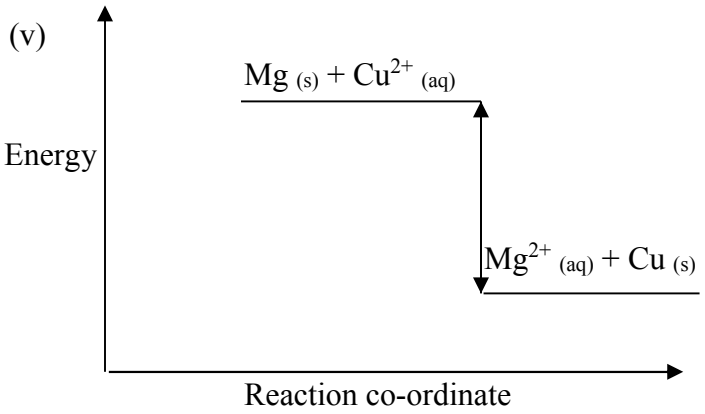
0.00625 = 1890 Joules

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

= -302.4Kj mol-1 (2mks)

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

(v)

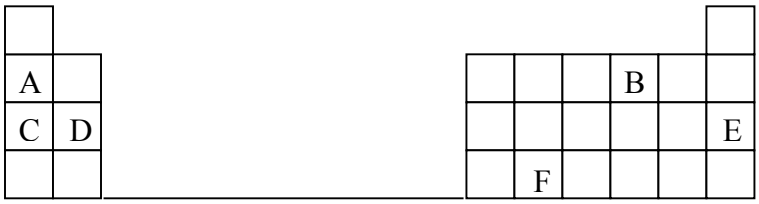


b) Zinc is higher than copper in the reactivity series of zinc is more reactive than copper or zinc will dissolve in the solution leading to weakening of the container or Redox reaction will take place. (2mks)

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

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

(ii)



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

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

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

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

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

Moles of D = 0.125

Mass of D 11.875-8.875 = 3g

3g

R.A.M of D = 24 (3mks)

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

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

(iii) SO_3 is absorbed in 98% conc. Sulphuric acid to make Oleum

Or $SO_2 + H_2SO_4 \longrightarrow H_2S_2O_{7(l)}$ (1 mk)

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

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

(vi) To minimize costs (mks)

b) i) Substance Observations

Iron filings -Effervescence starts and stops immediately.
- Bubbles of a colourless gas with a pungent smell.
- A brown solution is formed (1mk)

Crystal of white sugar - Black spongy solid(1mk)

ii) I Heating is required for conc.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) $CH_3COOH_{(aq)} + NaOH_{(aq)}$ $CH_3CO – ONa_{(aq)} + H_2O_{(l)}$ (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)

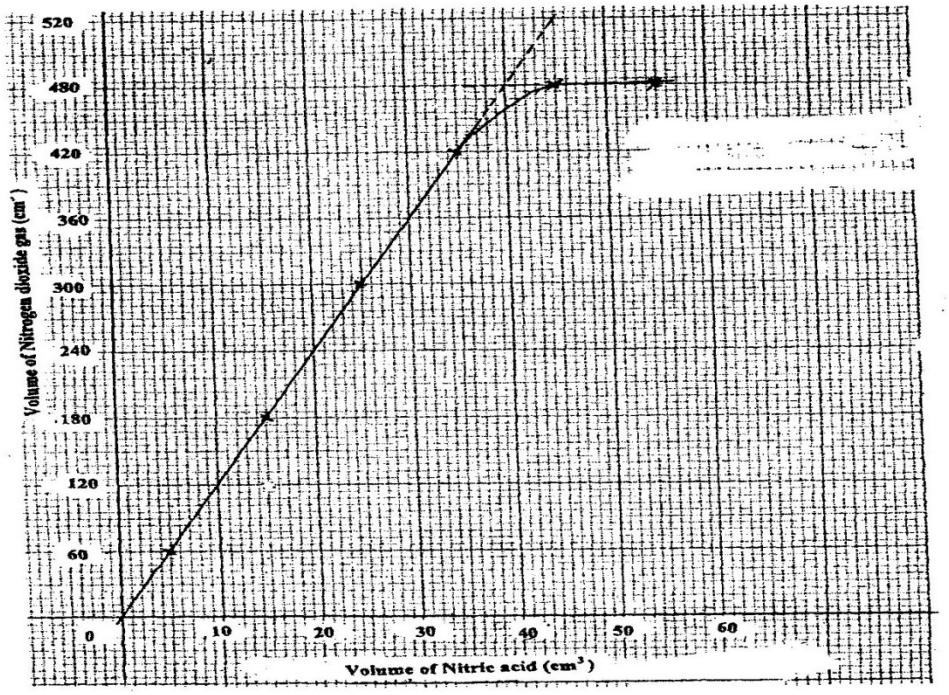
d) Cast iron is impure. (1mk)

(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 $= \frac{2.07}{2.07}$

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

$= 4000cm$ (2mks)

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

f) i) Moles of nitric acid That react with 1 mole of lead $= \frac{4000}{1000}$

$= 4$ (1mk)

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

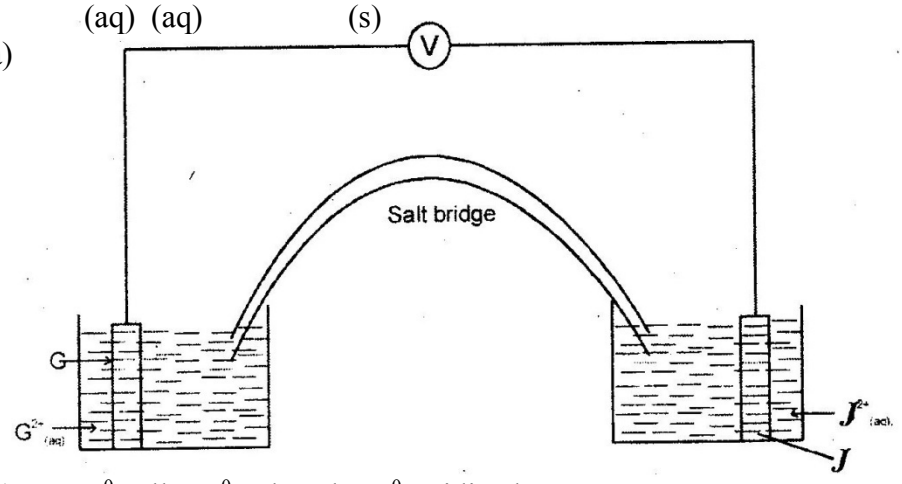
$= 2$ (1mk)

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

K.C.S.E 2007 CHEMISTRY PAPER 1233/1
MARKING SCHEMES

1. (a) Carbon (IV) oxide
   (b) Blue flame, carbon (II) oxide is burning
2. Mass in $500cm^3 = 15 \times 1.05 = 15.75g$
   Mass in $100cm^3 = 15.75 \times 2 = 31.5$
   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) $H_2O_2(g) \rightarrow H_2O_2$ $\Delta H^{cc}_f = -133kjmol^{-3}$
    ii) $H_2O(l) \rightarrow H2_{(g)} + O2_{(g)}$ $\Delta H_f = +188kmol^{-1}$
    iii) $H_2O(l) \rightarrow H2O_{(g)}$ $\Delta H_f = +55kjmol^{-1}$
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

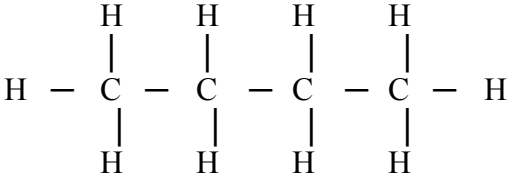
13. (a) (i) Deliquscency
(ii) Esterification
(iii) Thermal crucking

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

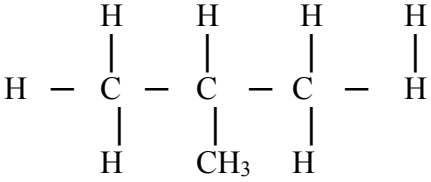
15. (a) The calcium and magnesium compounds in this water can not be decomposed by heating i.e. $CaCl_2$, $CaSO_4$, $MgSO_4$ and $MgCl_2$
(b) Ionic exchange
Uses sodium carbonate (washing soda)

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.

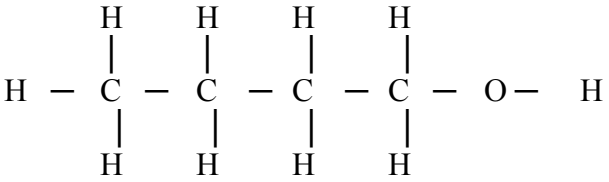
19. (a) Froth Floatation
(b) $ZnCO_3(g) \rightarrow ZnO_{(s)} + CO_2(g)$
(c) Manufacture of dry cells. Zinc casing forms the anode of dry cells

20. (a)

Element	C	H	O
%	64 1	21 1	13 1
Mole	5.4	1.3	13
Ratio	4	1	1

[E.F.= C_4H_9OH]

(b)



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 $Al_2(SO_4)_3 = \frac{6.84}{342} = 0.02$

Moles $a^2SO_4^{-2} = 0.02 \times 3 = 0.06$

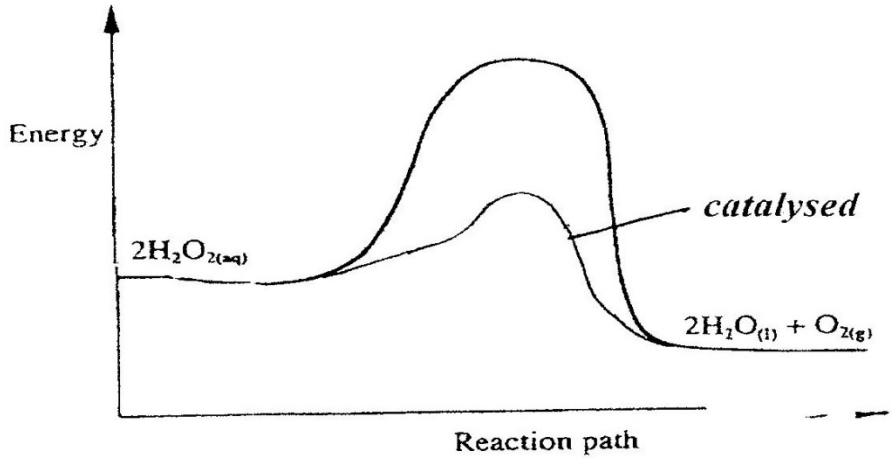
23. Pentene -1Al is polar. There are two forces, Vanderwaals and hydrogen bonds holding its molecules together. Pentene is non- polar.

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) $Ce = 1t = 5.0 \times 3 \times 60 = 54000c$
Mass of silver deposited

$= \frac{108 \times 54000}{96500}$

= 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)

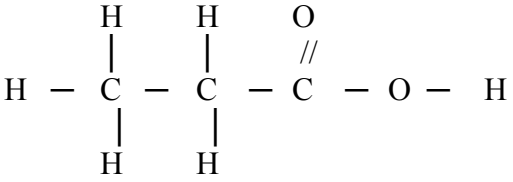
(d) - Heat less by radiation, conduction and convectional current
- Experimental errors when reading thermometer

2. (a) (i) 2-Methyl – Prop – i – ene
Pent – I – yne

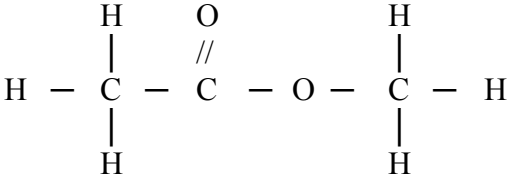
(b) (i) Change from orange to green
(ii) Effervescence and a colourless gas which burn with a 'pop' sound produced

(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 x 4 = 0.31496

Volume of HNO_3 = $\frac{0.031496 \times 1000}{3}$ = $10.49cm^3$

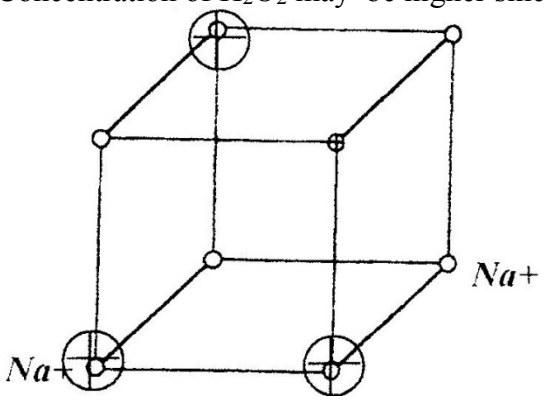
(b) Step 4 - Neutralization
Step 5 – Displacement

(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 x 6.0 x 10^8 = 7,20 x 10^{-6}
Concentration of H_2O_2 may be higher since concentration increases the rate of reaction.

5.



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

(b) Ammonia react with water to form ammonia solution

(c) Dative/ co-ordinate bond

(d) Allotropes

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

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

M.f = C_{60}

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

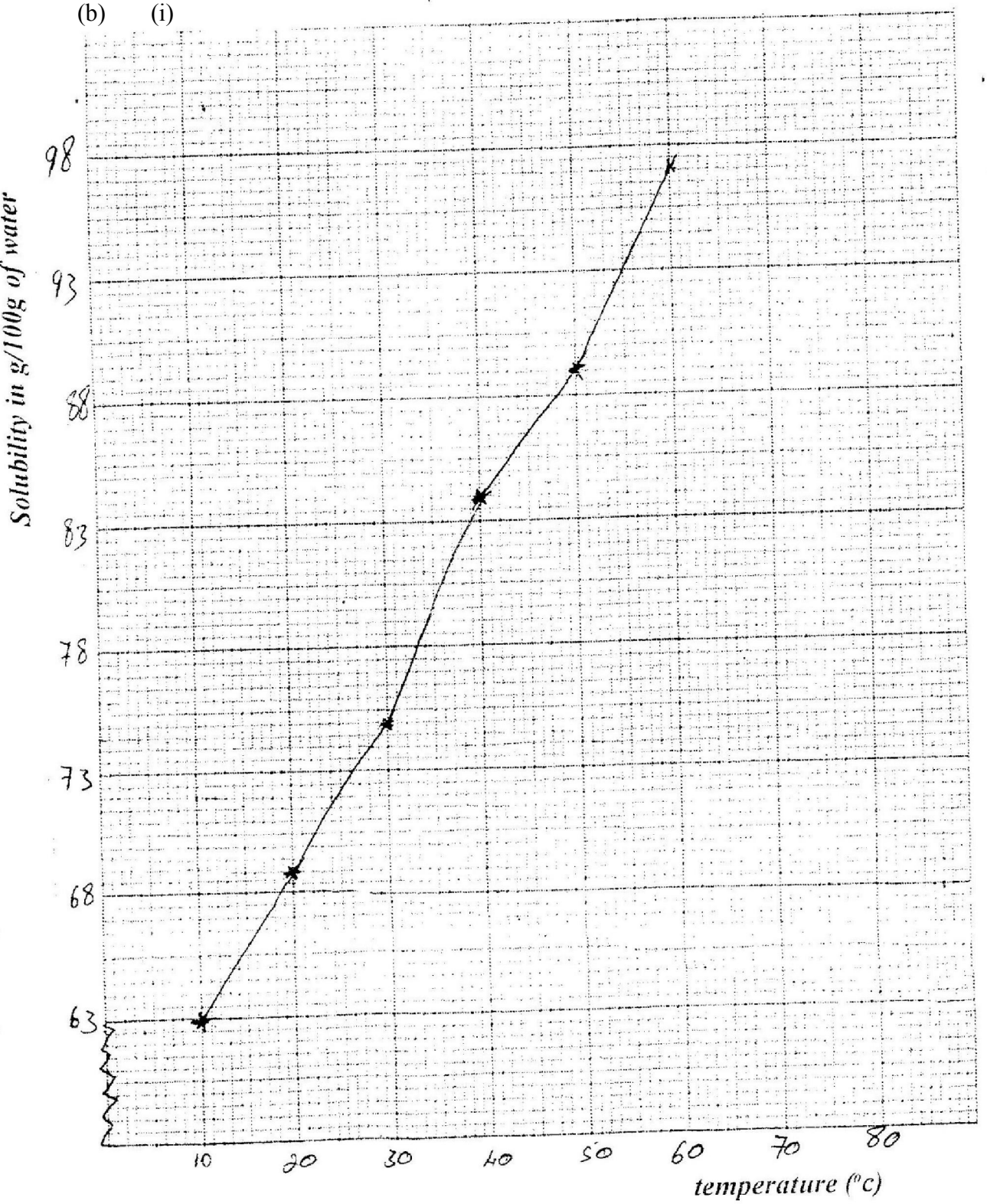
(ii) RMM of $(NH_4)_2 HPO_4$ = 132

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

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

100

(b) (i)


Solubility in g/100g of water
98
93
88
83
78
73
68
63
10
20
30
40
50
60
70
80
temperature (°c)

(ii) 71g/100mm of water

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

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

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

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

II Addition nitrogenic fertilizers which are acidic

7. (a) Carry experiment in a fume cupboard

Chlorine should not be allowed to escape to the atmosphere

(b) Mno_2 or $K_2Cl_2O_7$

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

(d) Aluminium chloride sublimes when heated

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

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

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

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

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

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

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 turn white/ the litmus paper bleached
II	Acidified must be th	Put a filter paper dipped in acidified potassium dichro (VI) into the gas	
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
O = 16 x 4 = 64/98

1 mole $Co_3(PO4)2$ gives moles of H_3PO_4
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)
   $Zn(s) + 2H_2SO_{4\,(I)} \rightarrow ZnSO_4(aq) + SO_2\,(g) + 2H_20_{(l)}$

10. Magnesium burns in air to form Mgo and Mg_3N_2, Mg_2N_2 reacts with water to Liberate ammonia gas
    $Mg_3N_2(s) + 6\ H_2O\ (I) \rightarrow 2NH_3\ (g) + Mg\ (OH)_2(ag)$

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.

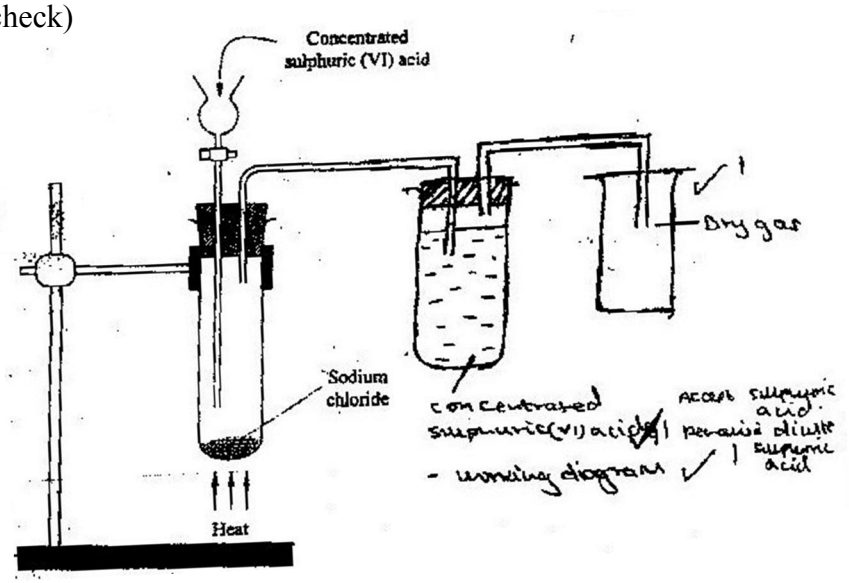
(b) $\sqrt{\frac{RW}{RX}} = \sqrt{\frac{RMMX}{MMWE}}$ $\sqrt{\frac{44}{16}}$

$\frac{12.0}{RX} = \frac{44}{4}$; $\frac{12.0 \times 4}{44} = \frac{48}{6.63}$

$= 7.24$ 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

$Mg(OH)_2 = \frac{0.67}{0.50} \times 100 = 13.34\%$

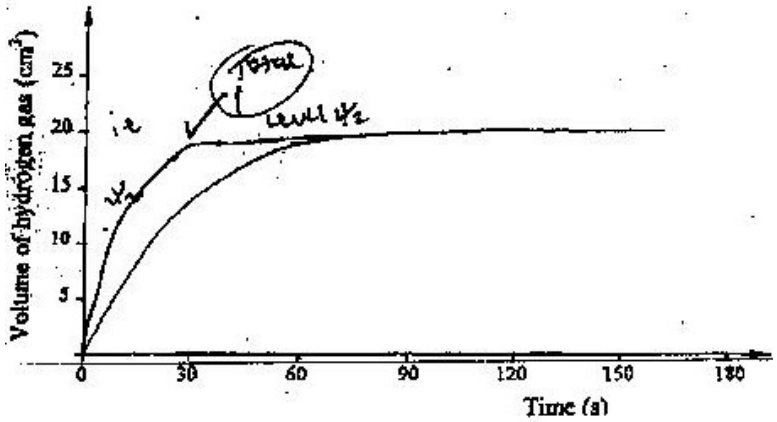
28. (a) (i) Cryolite

(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 $\frac{\text{Volume methane}}{\text{Volume of biogas}}$ x 100

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

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

Mass kg = 1.76 x 1000

= 1760 g

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

=110 moles

(ii) $CH_4 + 20_2 \rightarrow CO_2 + H_2O$

110 x 24 = 2,640

(c) (i) Global warning

(ii) I Ammonium nitrate

II Aerosols, Propellant, Freons

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

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

(b) (i) Period 2, two energy levels

(ii) A2 has greater atomic number than A1

A2 has greater nucleus charge than A1

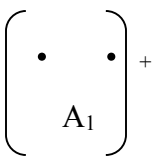
A2 has more protons than A1

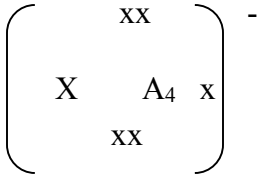
Therefore

I Across the period from left to right nuclear charge, exert greater pull on Electrons hence reduction in size.

II A4 gains electrons, incoming electron is repelled by existing electrons, electrons cloud increases.

(iii) A2

(iv) 



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

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

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

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

(iv) Fertilizer/explosive

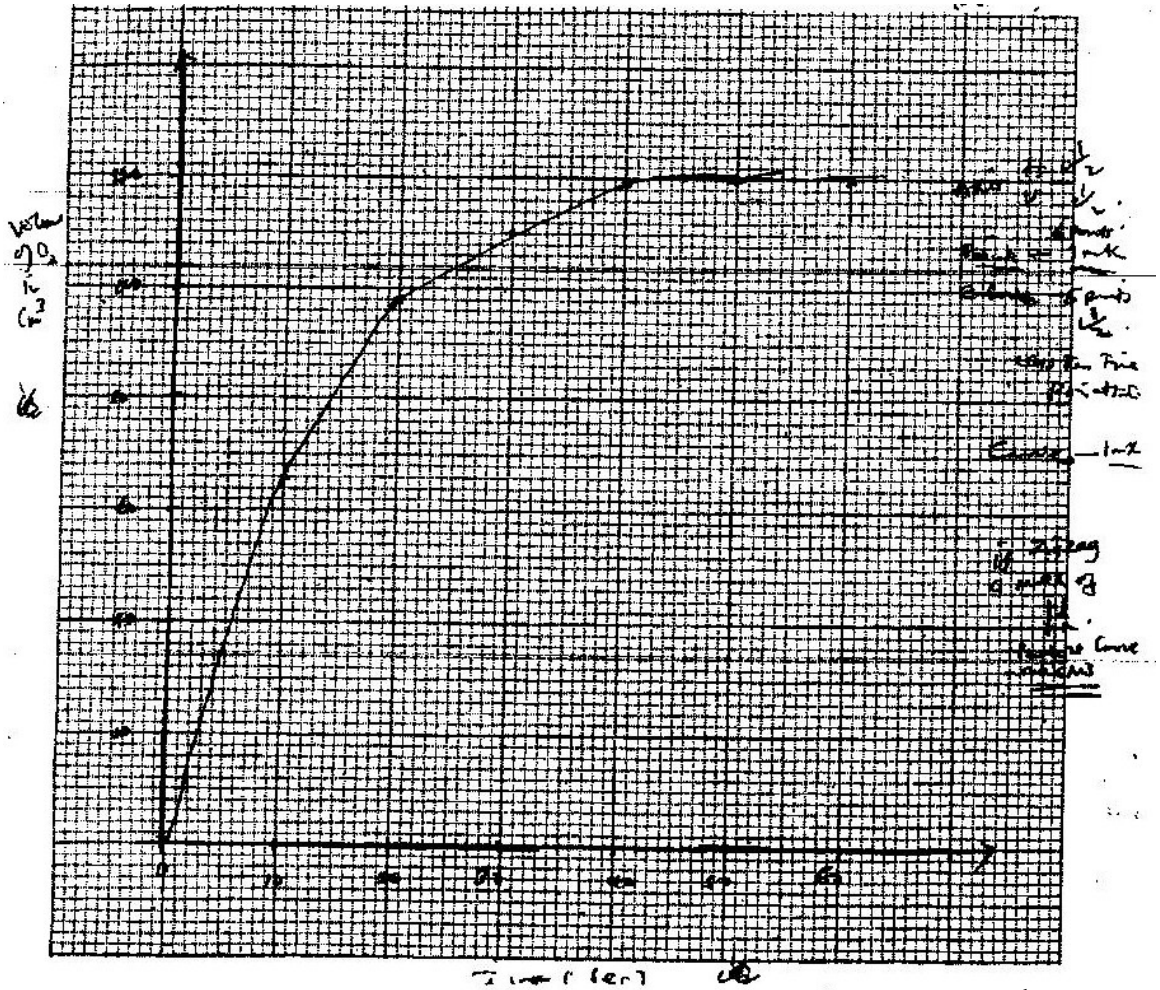
(c) (i) G or G^{2+}

(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



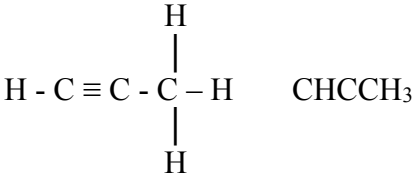
(iii) Drawing tangent at any time above 24 sec/ between 24th sec and 40 sec, correct use of tangent to calculate rate.

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)



CHCCH3

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

(ii) Ethane, CH_3CH_3, C_2H_6

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

II Hydrolysis - Hydrogen
- Oxidation
- Addition

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

(iv) Calculations of empirical formula mass = 28

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

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

(ii) N is an acidic compound/ alkanoic acid

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

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

OH oxidized to produce oxygen gas.

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

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

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

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

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

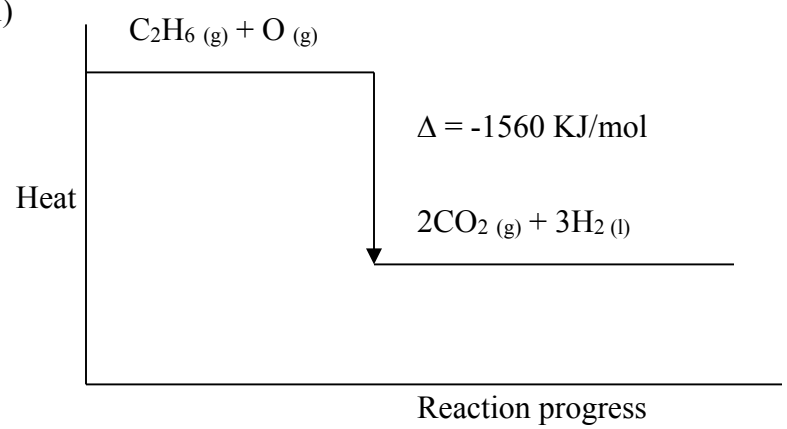
$$\frac{0.005596 \times 108}{1} = 0.60g$$

(iv) Prevent corrosion
Decoration/ improve appearance
Prevent turning of metals

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

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

(ii)



(iii) $2CO_2 + N_3H_2O_{(l)} \rightarrow C_2\ Hl_{(g)} + {}^{7}/_{2}\ O_2\ \Delta H = 1560$ kj/mol

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

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

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

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

$= 45.15$ KJ

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

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

$= 0.02894 \times 39$

$= 0.868$

K.C.S.E

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)

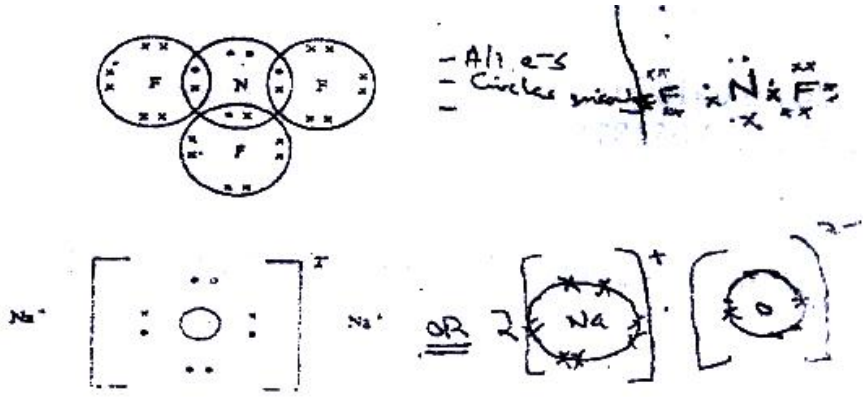
7. (a) $Al^{3+} + (l) + 3e^{-} \rightarrow AL\ (s)\ (l)$

(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

$\Delta H_2 = 406$ kJ mol -1 / Infinitely dilute solution

$\Delta H_3 = 335$ 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

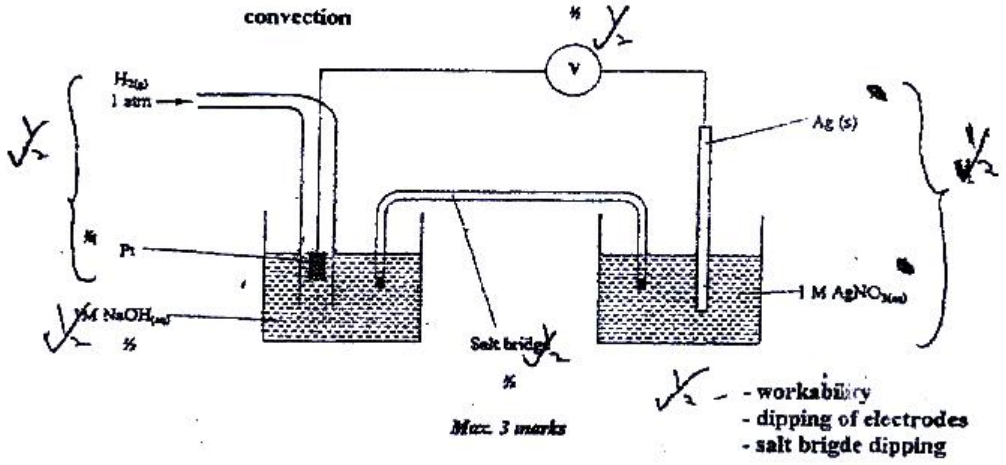
At cathode $2H^+$ (aq) + 2e→ H_2 (g) / $4N^+$ (aq) + $4e^+$ → 2 Hg

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)

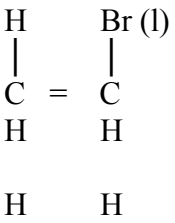
$\frac{4.41}{8.53}$

51. 693%5

Or 183

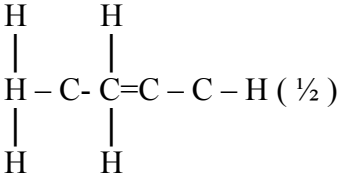
51.7% (3 mks)

14. (a)



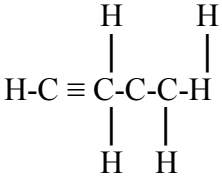
Bromoethane (l) / 1 bromoethane (2 mks)

(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)

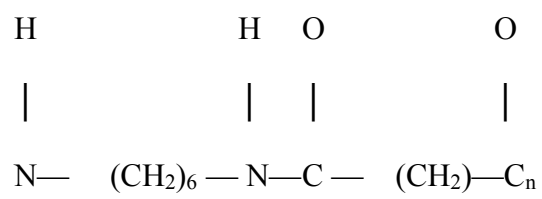
26. (a) Temperature and pressure are directly proportional (l) IR words towards that ofeal

(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 $= 0.0311 \times 3/2$

$= 0.047$

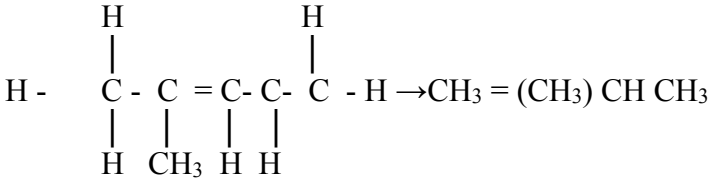
Vol of Cl_2 gas $= 0.047 \times 24$

$= 1.12\ dm^3$

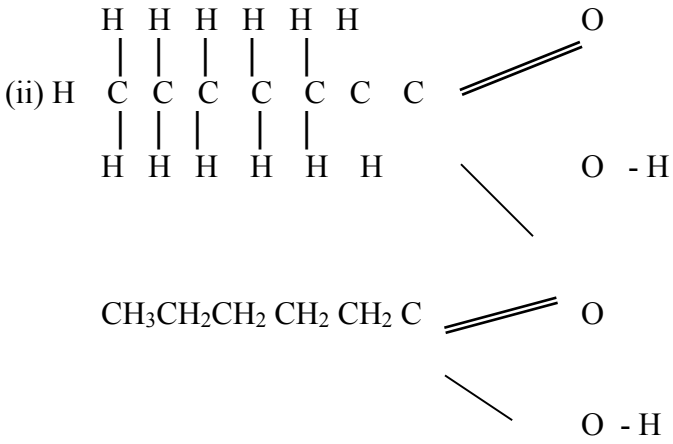
(iv)

- 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;



(ii)



(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 = $\frac{2.12 \times 100\%}{2 .15}$

= 98. 6%

b. - Used in textile industries - used in photography

- Manufacture of glass - Making anti acid drugs

- Softening hard water - In paper industries

- Making of detergents - As a food additive

5. (a)

(i) I. Condensation

II. Melting

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

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

(b)

(i) Van des waals and hydrogen bonding

II Van des waals forces

(ii) I. The separation distance is smaller during fusion than during vaporization hence requires much lower energy than in vaporization and vice versa.

II. Heating time NP is far much less than heating time in QR/ Heating time

(c)

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

- Hydrogen has a high energy content hence very small amount produce a lot of heat energy

- Hydrogen is renewable hence cannot be exhausted/ used completed.

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

6. (a)

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

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

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

Magnesium sinks in water/ slow (production of bubbles) effervescence/ solution becomes pink gradually.

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

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

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

$(2.34 + 169.2 + 236.2626)/100$ ½ mk

$= \frac{23797.80}{100}$

$= 237.978$ ½ mk

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

(iv) Control thickness of paper

(a) Coke/ coal/ Charcoal/ Carbon

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

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

(d) Slog is immiscible with molten iron

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

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

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

CHEMISTRY P 1 2010

1 a) Deliquescent – A substance that absorbs water from the atmosphere and changes into a solution

Hygroscopic – substance that absorbs water from the atmosphere but just becomes wet.

b) drying agent/used to test for water.

2 a) i) - Substance that cannot be split into simpler substance by chemical means *(must be named)*

- Substance that consists of one type of atoms
- A pure form a substance with unique atomic No.

ii) No of protons in an atom

Deny no. of electrons

b) $Ti_2(so_4)3$

$T_2(so_4)3$

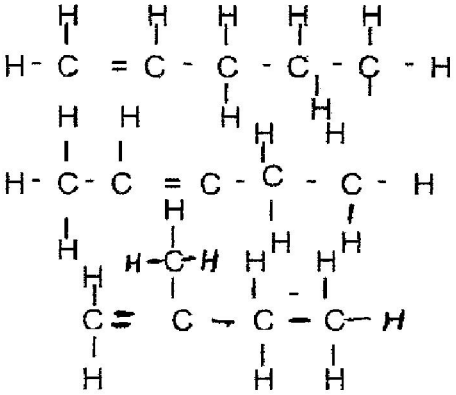
3 a) Ductility / Ductile

b) Activation energy

c) Vander waals force

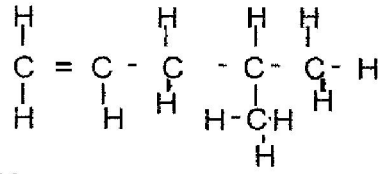
Don't accept intermolecular forces

4

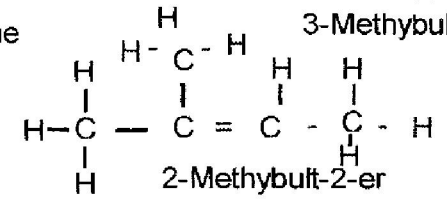


Pent - 1 - ene

Pent - 2 - ene



3-Methybult-1-er



2-Methybult-2-er

5. Heat the hydrated salt in a sealed container. The pink substance changes to blue. Allow gt500the blue substance to cool. It changes in a pink substance. Heat the hydrated salt. Pink substance changes to blue collect vapour and cool. Add liquid to blue solid it turns to pink.

6 a) $Al2O3 (s) + 6 Hcl (aq) \longrightarrow 2 AlCl3 (aq) + 3H20 (i)$ pen** ½ mk for wrong states

b) $Al2O3 = 2(27) + 3(16) = 102$ moles of $Al_2O_3 = \frac{153}{102} = 1.5$ moles

Moles of Hcl = $\frac{153}{102} \times 6 = 9$ moles

$1.5 \times 6 = 9$ moles

7.

Oxygen	Hydrogen
Copper ions	Copper metal

8. a) $\frac{P_1V_1}{T_2} = P_2V_2 \quad - \quad \frac{1.0 \times 10^8 \times 1}{77} = \quad \frac{1.0 \times 10^5 \times V_2}{298}$

$V_2 = \frac{1.0 \times 107 \times 298}{1.0 \times 10^5 \times 77}$ $\quad V_2 = 387.0\ dm^3$

b) No of moles $N_2 = \frac{387.0}{24.0}$ = 16.1 moles (No mark)
or 16.12: 16.125

Therefore Mass of N2 = 16.1 x 28 = 451.50g (Ans. to 2 d.p)

Accept 451.5g

(4.s.f)

Or 455.51g

9a) $^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}e$

b) i) 5.6×10^3 yrs | $5.6 - 5.7) \times 10^3$ yrs range

ii) 78% | 78 – 78.4%

+ 0.4 accept

10 a) Enthalpy of formation of hydrogen peroxide or Enthalpy of formation

b) $\Delta H1 + \Delta H3 = \Delta H2 \longrightarrow \Delta h3 = \Delta H2 - \Delta H1$

$= -285.8 - (-187.8) = 187.8 - 285.8 = -98 KJmol$

11. a) Fes | Hcl (accept formulas)

Iron (II) sulphide or Zinc sulphide / copper sulphide

Hydrochloric acid Lead (II) sulphide / HNO_3

b) Hydrogen sulphide

The sulphur changes from -2 to zero

(it reduces SO_2 to S) i.e +4 to 0 /

Sulphur lost e's in the H_2S to form sulphur

c) - Vulcanization of rubber | hard on rubber

- Manufacture of sulphur drugs

- Manufacture gun powder / match sticks / explosives / fungicides

12. a) CU^{2+} aqs + Fe (s) ⟶ CU (s) + Fe^{2+} (aq)

b) $\Delta H = MC\Delta T$; = 75.0 x 4.2 x 5.6 = -17645

moles of CU = $\frac{5.83}{63.5}$ = 0.0918

ΔH/mol = $\frac{1764\ h}{0.0918}$ = -19,215J (must have –ve sign)

= -19.2 KJ mol-12

Or -19.22kJmol^{-1}

13 a) Reagents - Hydrogen | H2

Condition – High temp 150 – 250^{0}C (range must be given)

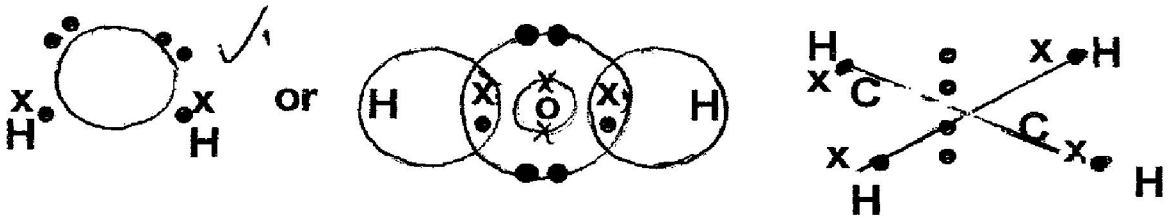
- High pressure not necessary
- Catalyst vol | pd | va

b) Reagent – sodium hydrochloride | NaoH

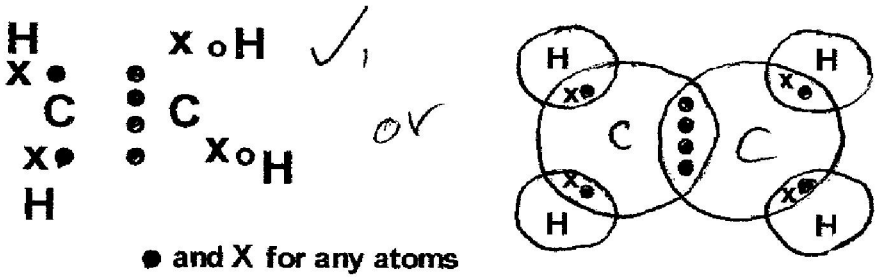
- Potassium "

Condition – Heating (don't accept warning to temp e.g 50^{0}C

14 i)



ii)



● and X for any atoms

b) Dative covalent bond | | Dative | co-ordinate

15 a) Gas has no colour and smell | odorless

b) Carbon (II) oxide has high affinity for iron in the hemoglobin in the blood / or displaces oxygen from hemoglobin therefore the body tissue are deprived of oxygen. Combines to form carboxyhaemoglobin - give one mk only

16 a) Add a few drops of NaoH to an aqueous solution of fertilizer. It forms white ppt insoluble in excess portion of aqueous solution or soluble sulphate of fertilizer. Forms a flame test. Take a solid and heat it. It burns with a red flame (1mk only)

b) Heat the sample fertilizer in a test tube, and test gas evolved with dump red litmus paper, it turns blue

or add NaOH to the sample fertilizer and heat the mixture, test gas evolved using damp red litmus paper turns blue or introduce a glass rod dipped in conc Hcl; white fumes observed.

17 a)

C	**H**	**O**
69.41	4.13	26.45
$\frac{69.42}{12} = 5.785$	$\frac{4.13}{1} = 4.13$	$\frac{26.45}{16} = 1.653$
$\frac{5.785}{1.653} = 3.5$	$\frac{4.13}{1.653} = 2.5$	$\frac{1.653}{1.653} = 1$
7	5	2

Empirical formula $C_7H_5O_2$

b) E.F.M = 7 (12) + 5 (1) + 2 (16) = 121

$(C_7H_5O_2)\ n = 242\ n = \frac{242}{121} - 2$

Molecular formula is $C_{14}H_{10}O_4$)

18a) Hydrogen gas | H_2

b) Increase surface area for faster reaction

c) - Pickling of metals
- Making of drugs
- Regulation of PH in the beer industry
- Treatment of sewage
- Making ion resins (don't accept manufacture of butter)

19 a) $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(l)$

Accept $\longrightarrow$

b) E.M.F = 0.40 - - 0.83 = 1.23 per cell

for ten cells = 10 x 1.23 = 12.3

c) Water formed can be used

water is not a pollutant

don't release harmful wastes

20a) NH_4NO_3 (s) N_20 (g) + $2H_2O$ (g) (accept gas)

b) Over warm water

Downward displacement of warm water because it is fairly soluble in cold water

c) Both red and blue litmus will not change colour

- both must be stated i.e. red and blue papers
- Don't award no observation made on papers
- Award no observable change on papers

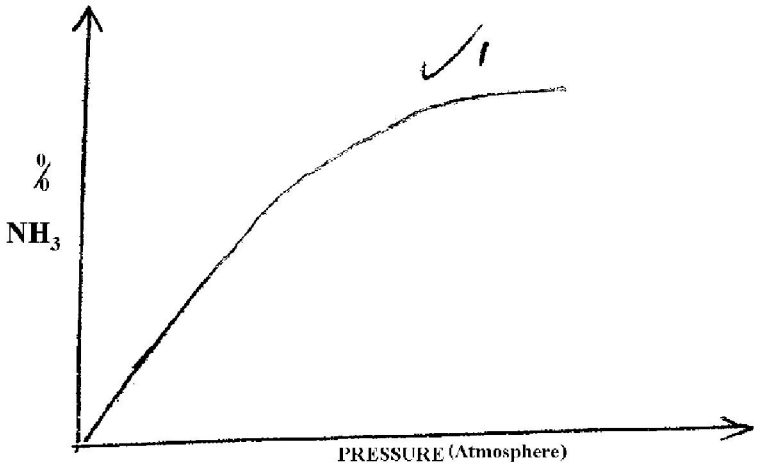
21 a) Chlorofluorocarbon

b) When ozone is depleted high energy UV radiation reach the earth which may cause skin cancer to human beings (if answer comes in b and has explained it in c then award)

c) Global warmings | or Green house effect

Don't accept acid

22a) Forward reaction is exothermic, therefore increase in temperature shifts position of equilibrium to the left direction in which heat is absorbed



23. Hcl is a strong acid // which is furry ionized in water while ethanoic acid is a weak acid // partially ionized in water.

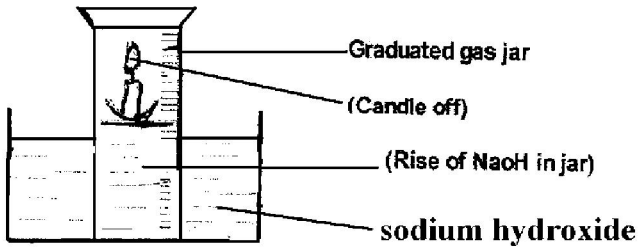
24. React iron metal with sulphuric acid to form iron (II) sulphate. React aqueous ammonia with sulphuric acid to form Ammonium sulphate mix the two solutions iron (II) sulphate and ammonium sulphate to form a solution of ammonium iron (II) sulphate evaporate, until crystallization starts then filter. Add excess H_2SO_4 the two salts in SO_2

react to form ammonium iron (II) sulphate evaporate until crystallization starts. Cool and filter to obtain ammonium iron (II) sulphate put iron metal in a beaker containing NH2 (aq). Add H_2SO_4 until efferveseen stops. Filter the solution obtained. Heat the filtrate to obtain ammonium iron (II) sulphate as a residue.

25.

Water hard containing Mg^{2+} | Ca^{2+} ions
Permanent hardness of water || Mg | Ca2+ $SO4^{2-}$ | Cl^{-1}
Na2CO3 removed the hardness || Hardness water was soft || Mg^{2+} | Ca^{2+} absent Mg^{2+} | Ca^{2+} are ppted out

26.



27 a) 2, 8, 8 | 2.8.8 ✓

b) $K^{+} < S^{2-} < P^{3-}$

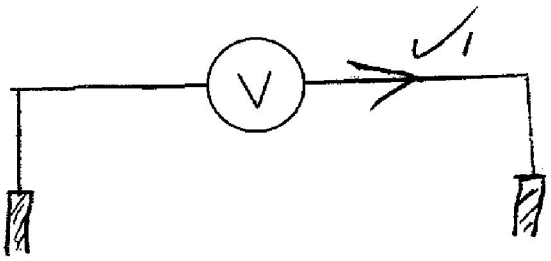
Potassium has 19 protons attracting 18 e's, sulphur has 16 protons attracting 18 e's, and phosporus has 15 protons attracting 18 e's. Therefore the electrons in potassium ions are attracted in potassium ions are attracted more strongly making it the smallest ion. ✓

CHEMISTRY P 2

1 a) - Ammonia or Copper (II) Chloride

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

b) i)



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

c) i) - Improve appearance/ beautify

- To prevent rusting/ corrosion

ii) 108 x (0.5 x 60 x 60)

1 x 96500

= 2.01g

2 a) i) - 2, 2-diamethylpropane

- Dimethylpropane

ii) Pent-2-yne

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

i) Does not decolourise the reagents

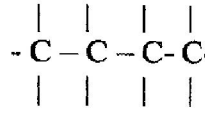
ii) Decolorizes the reagents or

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

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

II) CH_3CH_3 / Ethane

ii)



iii) - Water/ steam – Reagents

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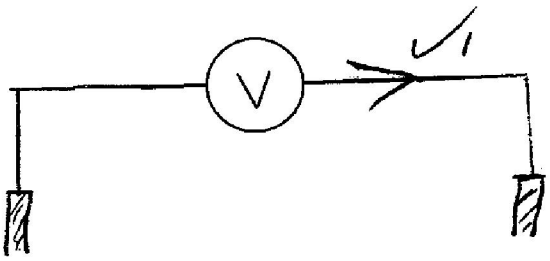

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$= 2.01g$

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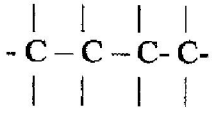

iii) - Water/ steam – Reagents

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

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

ii) - Blue colour disappears or a brown deposit formed

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

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

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

II) $CO(g) + \frac{1}{2} O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -283\ kJmol^{-1}$

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

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

Change in energy = 715 – 283 – 572

= -140

iii) - This is due to heat lost to surrounding

- Incomplete reaction
- Enthalpy of formation of CO not included

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

- The water produced may crack the flask

II) - Method of collection of gas wrong

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

ii) CaO

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

iv) - Pass dry HCL through ammonia

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

b) i) UNIT I

ii) NO / nitrogen (II) oxide

NO_2 / Nitrogen (IV) Oxide or NO.

iii) Nitrogen in NH_3 = -3

Nitrogen in $HNO_3 = +5$

- Increase in oxidation number / state is oxidation

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

Molar mass $NH_4NO_3 = 80g$

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

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

Molar mass of 63

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

$= 787.5kg$

OR

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

6 a i) ZnS

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

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

b) i) - Coke / Carbon

- Limestone ($CaCO_3$)

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

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

iii) - Vapour

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

iv) - $420 - 906^0C$

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

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

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

vi) - Making brass

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

7 a) i) - Curve I

- The concentration of products are increasing

Nitrogen in HNO_3 = +5

- Increase in oxidation number / state is oxidation

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

Molar mass NH_4NO_3 = 80g

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

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CHEMISTRY
PAPER 1 (MARKING SCHEME)
THEORY
2011

1. (a) Fermentation

   (b) Ethanol forms hydrogen bonds with water while Ethane does not / remains molecular / only weak Vanderwaals forces (intermolecular force. Ethane is non polar while Ethanol is polar.

2. (a) oe
   -1

   (b) 50g $\xrightarrow{t½}$ 25g $\xrightarrow{t½}$ 12.5g $\xrightarrow{t½}$ 6.25g $\xrightarrow{t½}$ 3.125g $\xrightarrow{t½}$ 1.5625g
   Or NW = $0.4(½)^n$
   NW = $50 \times (½)^5 = 1.5625g$

   (c) Instant / cause death
   Cause cancer
   Cause gene mutation

3. (i) Heat the mixture to sublime the NH_4Cl
   Add water to dissolve the NaCl or copper (II) oxide does not dissolve. Filter and evaporate the filtrate to obtain sodium chloride.
   (ii) Add water to the mixture to dissolve NH_4Cl and NaCl. Cuo does not dissolve. Filter and evaporate the filtrate to dryness. Heat to sublime NH_4Cl. NaCl remains behind.
   (iii) Add water to dissolve. Filter to obtain NaCl & NH_4Cl . Cuo does not undergo traditional crystallization i.e. concentrate and cool. NaCl crystallizes first.

4. (a) $NaNo_2$ reacts with NH_4Cl to form NH_4No_2. The NH_4No_2 decomposes to form N_2 gas. Or
   $NaNo_2$ (s) + NH_4Cl $\xrightarrow{NaCl}$ (s) + NH_4No_2(s)
   $NH_4No_2(s) \longrightarrow N_2$ (g) = $2H_2O$ (l)

   (b) Provides inert atmosphere in certain industrial prcesses e.g. packaging / used in light bulbs.
   Storage of semen (for artificial insemination)
   Drilling of oil to provide inert atmosphere
   Dilute effect of O2 gas
   Fill aircraft tyres
   Fill empty oil tankers
   Provide inert atmosphere during welding

5. (a) 2;8 / 2.8 / 2,8 / 2:8 / 2 8 deny 2-8

   (b) $3v\ (s) + Q_2\ (g) \longrightarrow V_3Q_2\ (s)$
   Or $3Mg\ (s) + N_2\ (g) \longrightarrow Mg_3N_2(s)$ or N_2Mg_3

   (c) T has a lower ionization energy than M or M higher than T.
   T has an extra energy level and hence e's are less attracted by the positive nucleus M has higher e's are more attracted.

6. $\frac{P_1V_1}{T_1} + \frac{P_2V_2}{T_2} = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2} = \frac{98,648.5 \times 0.15 \times 273}{293 \times 101,3285}$

   $V_2 = 0.136 dm^3$ (go to minimum of 2d.p)

7. (a) $2\ Pb\ (No_3)_2\ (s) \longrightarrow 2PbO\ (s) + 4\ No_2\ (g) + O_2\ (g)$

   (b) Moles of No2 gas = $\frac{0.29}{24} = 0.01208$

   Moles of $Pb\ (No_3)_2$ = ½ x 0.01208 = 0.006 or ½ x $\frac{0.29}{24}$ = 0.006

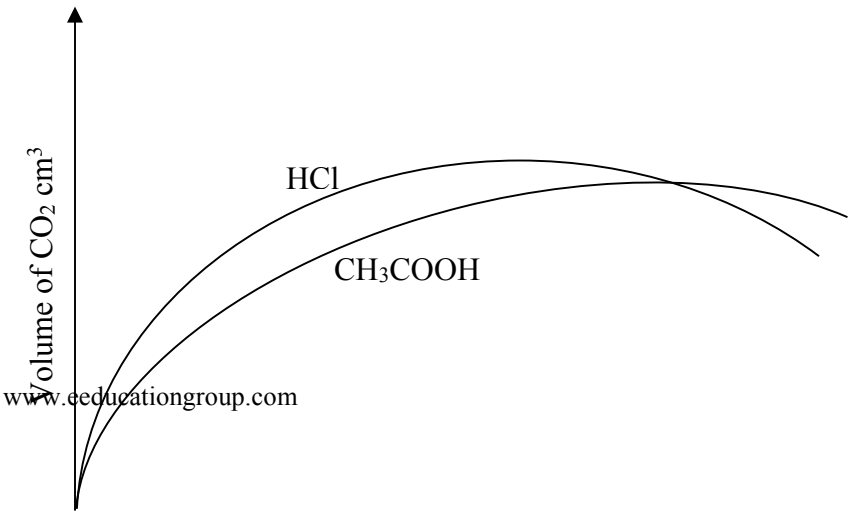
   Mass of $Pb\ (No_3)_2$ = 0.006 x 331 = 1.9998g / 1.986 g

   Or 2 moles $Pb\ (No_3)_2$ 4 x 24 dm^3 No_2 (g)

   $\frac{0.290 \times 2 \times 331}{4 \times 24} = 0.290\ dm^3$
   = 2g

8. (a) An acid that ionizes fully / dissociates fully / completely gives all the H^+ ions

   (b) Curves start at the same point. Curve of Hcl above ethanoic. Curve ethanoic below. Joining at some point.



9. It is expensive

Time (min)

It is explosive
It is difficult to store

10. (a) Greenish yellow / pale green colour of Cl_2 disappears
Brown solution / black solid is deposited

(b) Cl_2 (g) + 2 I^- (aq) 2 Cl^- (aq) + I_2 (s)
Explanation; Iodine oxidation state changes from -1 to 0 hence oxidation while Cl_2 0.5 changes from 0 to -1 hence reduction / increase is ON and decrease is ON or movement of electrons Cl_2 gains e's where lose.

11. (a) Carbon (II) oxide is formed when fuel burns under limited oxygen / incomplete combustion of fuel.

(b) Carbon (IV) oxide / Co_2 – Sulphur (VI) oxide / So_3
Nitrogen (IV) oxide / NO_2
Sulphur (IV) oxide / So_2

12. (a) Small piece of sodium metal (pea size) with a lot of water
Perform the experiment wearing goggles.

(b) Electrolysis

(c) Manufacture of paper (soften)
Manufacture of soaps and detergents
Fractional distillation of liquid air
Extraction of aluminium metal
Manufacture of bleaching agents eg NaOCl paper, textiles, oil refinery
Making herbicides on weed killers
It is boiled with
Textile industry to soften

13. Deliquescent substance absorbs water from the atmosphere to form a solution / dissolve.
Efflorescent substance loses water of crystallization to the atmosphere.

14. P is an alkanol / alcohol
The alkanol reacts with sodium metal to produce the colourless gas / H_2 gas

15. (a) $Ca(st)_2$ or $Mg(st)_2$

$Ca(st)_2$ or $Mgst_2$
$Ca(C_{17}H_{35}COO)_2$ or $Ca\ (c_{17}H_{35}COO)_2$

(b) $Ca^{2+}\ (aq) + CO_3^{2-}\ (aq) \longrightarrow CaCo_3(s)$
Or $Mg^{2+}\ (aq) + Co_3^{2-}\ (aq) \longrightarrow MgCo_3\ (s)$

16. By adding conc H_2So_4 as a catalyst / adding H_2So_4

17. (a) (i) Black solid is deposited. Lead (II) sulphide (Pbs) is formed
Bubbles are produced and seen. Gas is produced which is H_2S passes through the solution.

(ii) The indicator turns red/pink/orange. This is due to excess H_2S and/or SO_2 gas (formed are acidic)

(b) The experiment should be done in a fume chamber or in open air

18. (a) At room temperature cold and dilute sodium hydroxide

(b) Used in sterilizing of water / treatment of water / killing germs
Used as a bleaching agent
Antiseptic for mouth wash
Fungicide

19. Plot A (Urea)
% of N_2 in $(NH_4)_2\ SO_4 = \frac{28}{132} \times 100 = 21.2\%$. Amount in 50kg $= \frac{21.2}{100} \times 50 = 10.6$ kg

Plot B ($(NH_4)_2SO_4$
% of N_2 in urea $= \frac{28}{60} \times 100 = 46.7\%$. Amount in 30kg $= \frac{46.7}{100} \times 30 = 14.01$kg
Plot B is more enriched with N_2 since it has a higher amount of N_2 than Plot A.

20. Add universal indicator to match the colour of solution with pH chart and read the value using a pH meter.
Add water to dissolve the anti-acid powder. Dip electrodes directly into solution and read the pH from the screen.

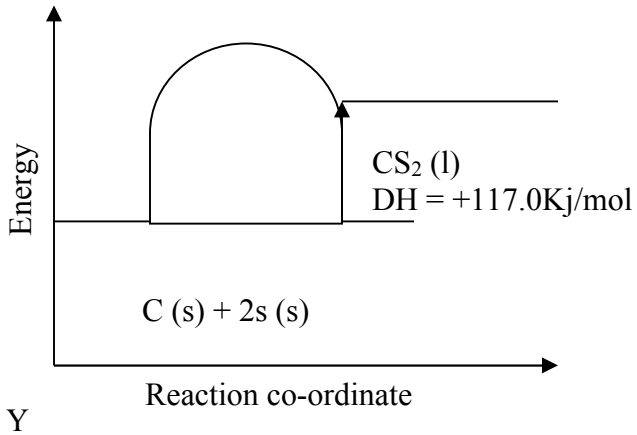
21. (a) Sulphur / Phosphorous / oxygen

(b) Carbon atoms in graphite are arranged in layers of hexagon which are held by weak van der waals forces. The layers slide over each other when force is applied.

22. (a) Bromite
At room temp (25°c) Bromite is liquid since its M.P and B.P is between -7°c and 59°c /58.8°c. Room temp is between M.P and B.P

(b) Atomic mass / molecular mass / molecule of iodine is higher than that of Cl_2.
Van der waals forces are stronger in I_2 than Cl_2 hence iodines b.p is highest than that of Cl_2

23.



24. (a) Y

(b) Y and Z. They have the same number of protons (8) but different atomic masses / mass numbers / no of neutrons.

25. (a) When gases combine together at constant temp and pressure they do so in volumes which bear a simple ratio to each other, and to the volumes of the products if gaseous.

(b) $C_2Hx\ (s) + 3O_2\ (g) \longrightarrow 2CO_2\ (g) + 2H_2O\ (g)$

Vol	10	30	20	20
Mol Ratio	1	3	2	2

Therefore X = 4

26. (a) (i) 10.352 – 10.240 = 0.112g

(ii) 10.400 – 10.352 = 0.048g or (10.400 – 10.240) – 0.112 = 0.048g

(b)

Elements	M	O
Mole ratio	$\frac{0.112}{56}$	$\frac{0.048}{16}$
	0.0020	0.0030

Simplest Ratio	2	3
E.F	M_2O_3	

27. (a) Zinc blende or/ calamite

(b) $2\ ZnO\ (s) + C\ (s) \longrightarrow 2Zn\ (s) + CO_2\ (g)$
$ZnO\ (s) + C\ (s) \longrightarrow Zn\ (s) + CO\ (g)$
$3ZnO\ (s) + 2C\ (s) \longrightarrow 3Zn\ (l) + CO_2\ (g) + CO\ (g)$
$ZnO\ (s) + CO\ (s) \longrightarrow Zn\ (s) + CO\ (g)$

(c) Dry cells
Galvanizing iron sheets
As electrodes
Making of alloys e.g. brass

28. (a) Single covalent bonding / covalent
Dative / co-ordinate bonding

(b) 7 bonds x 2 = 14 electrons

29. (a) Mg metal has free/mobile delocalized electrons which may carry the current.

(b) It has (Mg^{2+} and Cl^-) ions which are free/mobile to move. Accept if ions only. Not necessarily free/mobile.

30. Add aqueous ammonia until in excess.
A formation of white ppt which dissolves in excess shows presence of zinc ions.
Add aqueous acidified $Ba(NO_3)_2/BaCl_2/Pb(NO_3)_2$.
Formation of a white ppt shows presence of SO_4^{2-} ions

31. Alkaline earth metals

2011

CHEMISTRY
PAPER II

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

(a) Describe how oxygen is obtained from air on a large scale (3 marks)

Purity to remove impurities, bubble through NaoH/KoH to remove CO_2, reduce the temp, to remove water vapor compress to liquefy the residual air, then fractional distillation to obtain oxygen at -183^0C

(b) (i) Name substance A. (1 mark0

Concentrated sulphuric

(vi) acid

(ii) Write an equation for the process that takes place in the absorption chamber (1 mark)

$SO_{3(g)} + H_2SO_{4(l)} \_ H_2S_2O_{7(l)}$

(c) Vanadium (V) oxide is a commonly used catalyst in the contact process.

(i) Name another catalyst which can be used for this process. (1 mark)

Platinum/platinum asbestos

(ii) Give two reasons why vanadium (V) oxide is the commonly used catalyst

It is cheap/cheaper (2 marks)

Not easily poisoned/action stopped by impurities

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

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

(e) The reaction of concentrated sulphuric (VI) acid with sodium Chloride produces hydrogen chloride gas. State the property of concentrated sulphuric (VI) acid illustrated in this reaction.

It is less volatile/volatility / involatile

(f) Name four uses of sulphuric (VI) acid. (2 marks)

Manufacture of sulphate fertilizer/superphosphate fertilizer/production of Ray on making dyes/used in car batteries/ As an electroly manufacture of sosaples detergents/cleaning of metals manufacture of pain HCL/HNO_3/Oleum.

As a drying agent, as adehydrating agent/manufacture of nylon

$AL_2SO_4/ALCOH_3$/sulphate drugs, pigments

2. The set-up below was used by student to investigate the products formed when aqueous copper
3. (II) chloride was electrolysed using carbon electrodes.

(a) (i) Write the equation for the reaction that takes place at the cathode.(1 mark)

$CU^{2+}{}_{(G)} + 2E - CU_{(S)}$

(II) Name and describe a chemical test for the product initially formed at the anode when a highly concentrated solution of copper (II) chloride is electrolysed.(3 marks)

Chlorine gas

Moist blue litmus paper/fresh or moist coloured petals/ change from blue to white/

(III) How would the mass of the anode change if the carbon anode was replaced with copper metal? Explain. (2 marks)

Decrease the anode is not inert so I+ dissolves/reacts/iodine oxidized

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

(c) The electrode potentials for cadmium and Zinc are given below:

Cd2+ (aq) + 2e ___ Cd (s) ; $E^{\ominus}$ = - 0.4v

Zn2+ (aq) + 2e ___ Zn(s) ; $E^{\ominus}$ = - 0.76v

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

Zinc reacts with cadmium ions/displaces/cadmium ions/Zinc container dissolve because Zinc is more reactive/Electropositive than calmium or calculate

Zn is a stronger reducing /Zinc is oxidized

4. (a) Ethanol can be manufactured from ethane and steam as shown in the equation below:

$C_2H_{4\,(g)} + H_2O\,(g)$ _____ $CH_3CH_2OH_{\,(g)}$

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

Concentration/volume

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

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

(i) State whether the reaction between ethane and steam is exothermine or endothermic. Explain your answer. (3 marks)

Exothermic I increased in temp at constant pressure. The amount of ethabol formed at eqm decreases and vise versa decrease in temp at

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

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

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

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

Time (minutes)	1	2	3	4	5	6
Volume of carbon (IV) oxide (cm^3)	170	296	405	465	480	480

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

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

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

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

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

(c) Calculate the mass of calcium metal which reacted with copper (II) nitrate solution. (relative atomic mass of Ca=40) (2 marks)

No of moles of = $50/_{1000}$ x 2
Copper (ii) nitrate
= 0.1 moles
Ratio 1:1
Moles of Ca = 0.1
Mass of Ca = 0.1x40
=4g

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

(e) (i) Starting with calcium oxide, describe how a solid sample of calcium carbonate can be prepared. (3 marks)
Add Cao to dil HNo_3/Hcl/H_2O. Add Na_2CO_3/K_2CO_3/NH_4 CO_3/CO_2 a solution filter out CaCO3 as residue.

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

6. (a) Other than their location in the atom, name two other differences between an electron and a proton. (2 marks)
Electron is negatively charged while proton is positively charged
Electron has a mass of units while proton has a mass of unit
Mass of proton is bigger that that of electron.

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

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

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

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

(iii) Write the formula of the compound formed when E combines with G.

- $E_2 G_3/AL_2 O_3$

(iv) Name the type of bond formed in (iii) above. (1 mark)

- Ionic bend/electrovalent

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

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

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

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

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

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

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

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

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

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

- Hexan – I –OI

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

- $CH_3 – CH = C-CH_3- CH_3$

8. (a) What is meant by molar heat of combustion?
Amount of heat liberated/energy change when o ne mole of a substance is burnt in excess oxygen
(b) State the Hess's Law
Heat obsorbed/evolved in a chemical change is the same regardless of the route taken
(c) Use the following standard enthalpies of combustion of graphite,hydrogen and enthalpy of formation of propane.

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

- $3C(s) + 4H_2 (g)$ ____ $C_3 H_8 (g)$

(ii) Draw an energy cycle diagram that links the heat of formation of propane with its heat of combustion and the heats of combustion of graphite and hydrogen. (3 marks)

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

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

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

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

(e) The molar enthalpies of neutralization for dilute hydrochloric acid and dilute nitric (V) acid are -57.2KJ/mol while that of ethanoic acid is -55.2kJ/mol. Explain this observation. (2 marks)

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

K.C.S.E CHEMISTRY PAPER 1 2012
MARKING SCHEME

1. a) Carbon (iv) oxide /CO_2/ carbon dioxide
Carbon (II) oxide/ CO/ carbon monoxide

b) - Fire extinguisher/ photosynthesis
- Refrigeration
- Solvay process
- Fizzy drinks
- Food preservation
- Extraction of metals
- Manufacture of methanol
- Manufacture of fuel (water, gas)

2. Add water to dissolve $CUSO_4$, Fe_2O_3 doesn't dissolve
- Filter out the undissolved Fe_2O_3
- Wash the residue with plenty of water ro remove traces of the filtrate.
- Dry the residue between the filter papers

3. Grey solid deposited, PbO has been reduced to lead metal; colourless liquid condenses hydrogen has been oxidized to water

Or

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

Or

$H_{2(g)} + PbO \rightarrow Pb_{(s)} + H_2O_{(l)}$
Yellow /grey/

4. a) BDAC; Across the period the atomic radius decreases/ no. of protons/ nuclear charge increases.
CADB; from right to left size increases.

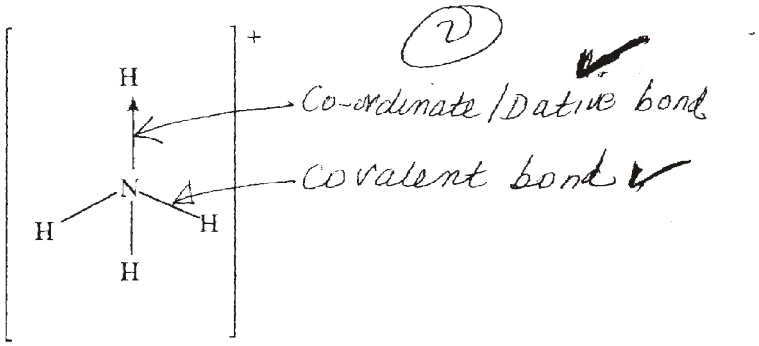
b) D
Across the period the conductivity increase due to increase in delocalized electrons/ mobile/ free/ valency electrons

5. Water contains impurities; impurities increases/ raise/
Water contains ions

6. a) CUSO4; at 40^oC only 28g is soluble leaving undissolved $CUSO^4$ while all $Pb(NO^3)^2$ dissolves.

b) 35 – 28 = 7g

7.



a) Or N – H

b) Or N→ H

8. $H_2SO_{4(aq)} + 2NaOH(aq) \rightarrow Na_2SO_{4(aq)} + H_2O_{(l)}$

Or

Moles of NaOH $= \frac{36 \times 0.1}{1000} = 0.0036$moles

Moles of acid ratio 1:2

$\frac{0.0036}{2} = 0.0018$moles

Mass $H_2SO_4 = (2 \times 1) + 32 + (4 \times 32) = 98$

Moles of acid $= \frac{0.0018 \times 100}{10} = 0.018$moles

$98 \times 0.018 = 1.764$g

Or

$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O_{(l)}$

1 : 2

Moles of NaOH $= \frac{36 \times 0.1}{1000} = \frac{3.6 \times 10^{-3}}{2}$ moles $= 1.8 \times 10^{-3}$ moles

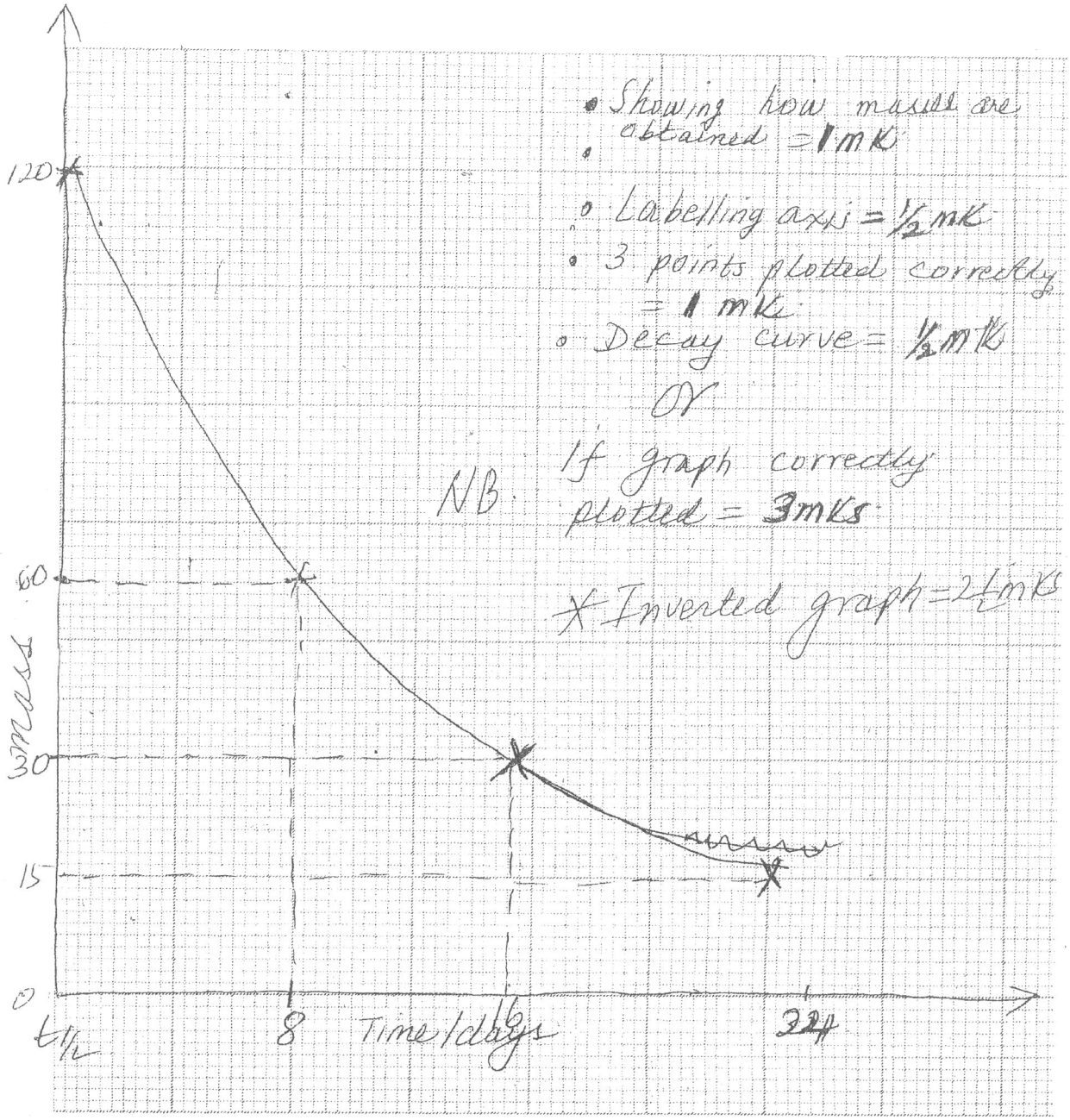
$\frac{1.8 \times 10^{-3} \times 100}{10} = 0.018$moles

$H^2SO_4 = 2 + 32 + 64 = 98$

$98 \times 0.018 = 1.764$g

9.

Mass	120	60	30	15
Time	0	8	16	24



10. a) Ca^{2+}, Mg^{2+} ion Or magnesium ion
Calcium ion

Rej Magnesium or calcium

b) Ca^{2+}/ Mg^{2+} are exchanged with Na^{+} ion in charge resin/ ions in hard water are exchanged with Na+ ion in the resin.

11. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ or $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_2 = \frac{56 \times 1 \times 273}{548}$

$= 28cm^3$

$\frac{0.47 \times 22400}{28} = 376$

R.F.M of $CH_2Br = 94$

$94n = 376$

$\therefore n = 4$

$MF = (CH_2Br)_4$

$= C_4H_8Br_4$

NB if $56cm^3$ is used

$n = 2$

mfc, H_4Br_2

12. a) CaO/ Calcium oxide/ quick lime

b) 1. Expose NH3(g) to HCL(g), dense white fumes form or use of equation.
2. Dump red litmus paper turns blue when exposed to ammonia.
3. Use of indicators or
4. Pass the gas in Ca2+ ions a pale blue ppt which dissolves to give a deep blue solution is seen

c) X – steam/ water vapour/ water

13. - Catalyst has no effect on position of equilibrium
- A catalyst will increase the rate of forward and backward rxn by equal amount
- A catalyst reduces time for establishment of equilibrium
NB marks are tied
Or
Equilib shifts to the right – because iron reacts with steam

14. Ionisation energy – is the energy required to remove an electron from an atom in gaseous state.
Electron affinity – is the energy change that results in the formation of an ion when an atom gains an electron.

15. a) Salt bridge

b) Emf = E$\ominus$ reduced - E$\ominus$ oxidized
= - 0.80 – (-0.13) or 0.13 – 0.8
= - 0.670

Or
Emf = E $\ominus$ reduced – E $\ominus$ oxidized
= - 0.13 – (-0.8) or -13 + 0.8
= +0.67V

Or

Emf = +0.80 – (-0.13)
or 0.80 + 0.13
= + 0.93V

16. a) S.H.V.T = 2mks if TVHS – student must show the direction of reactivity
NB if SVHT – award 1mk; if any letters missing award 0

b) $T_{(s)} + V^{2+}_{(aq)} \rightarrow T^{2+}_{(aq)} + V_{(s)}$

17. a) Heat or rxn/ Heat change or rxn/ enthalpy of rxn or molar heat of rxn

b) - Using a catalyst
- A catalyst lowers/ reduces the activation energy.

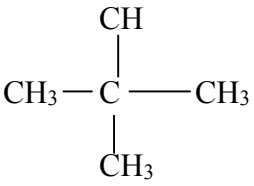
18. a) SO_2/ sulphur (IV) oxide
- Oxidation number of S increases from +4 to +6.

b) - Food preservation
- Bleaching agent
- fumigant
- disinfectant

19. - Level of water in glass tube goes down
- $H_{2(g)}$ gas being less dense than air diffusing or faster than air into the porous pot

20. - $CH_3 - CH_2 - CH_2CH_3$ pentane

$CH_3 - CH - CH_2 - CH_3$ 2-methly/butane
|
CH_3



21. Plastic bottles, tooth brush handles
Packaging materials, making crates, cups, plates.
Building materials, models ceiling boards.

22. a) i) Can be hammered into sheets.

ii) Can be drawn into wires.

b) i) Making of sufurias/ motor vehicle parts/ aeroplane parts
window / door flames, cups, plates, packaging materials, pans, making sheets/ roof.

ii) electricity cables/ wires.

23. 1 Weigh $CUCO_3$
2. Heat $CUCO_3$ to a constant mass/ add acid
3. Reduce CUO using H_2NH_3 or CO
4. Weigh the copper
5. % CU = $\frac{\text{Mass of CU}}{\text{Mass of } CUCO_3} \times 100$

Weigh $CUCO_3$ heat$\rightarrow CUCO_3 \rightarrow$Reduce CUO $\rightarrow$weigh CU $\rightarrow$% CU

24. a) There is (No air (no O_2) due to boiling.

b) 1 Al forms a protective AL2O3 layer
2. Al being more reactive than non rusts fast/sacrificial or cathodic protection

25. Vol of 2KOH = 100cm3 (or mols = $\frac{0.4}{2}$ = 0.2

- Mix the $KOH_{(aq)}$ and H_2SO_4 acid
- Concentrate the mixture/ heat the mixture
- Crystalise the solution (or heating the solution to dryness)
- Dry crystals

26. - Add Na_2CO_3/ $NaHCO_3$ to each with ethanoic these is efferscence no rxn with ethanol.
- Add acidified $KMnO_4$ or $K_2Cr_2O_7$, ethanol decolourine $KMnO_4$ or change K_2CrO_7 from orange to green, no change with ethanoic acid.
- Using indicator or litmus papers, no effect with ethanol, while ethanoic acid affect litmus or indicator (phenolphthalein reject)

27. a) Group - 5 (or V) (or five)

Period – 3/ III/ or three

b)i) Noble gases/ inert gases/ rare gases

ii) In balloons (helium)
- Fluorescence lamps/ light bulb

- Disco lights
- Arc welding
- X-ray tubes
- In diluting O_2 in gas cylinder, deep sea diving.

28. a) $2CL^-_{(aq)} \rightarrow CL_{2(g)} + 2e^-$
Or $2CL^-_{(aq)} - 2e \rightarrow CL_{2(g)}$
NB Penalise state symbols/ balance.

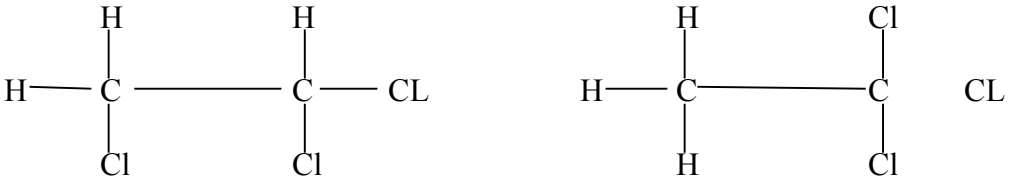
b) - O_2/ oxygen
- OH^- ions will be in higher concentration
- OH^- ion being higher in the electro motive series/ or are easier to discharge or lower in the electrochemical series than the chlorine ions hence preferentially discharged or OH- has a higher –ve potential.

29. a) - No effect / change HOCL = chloride (I) acid ion
- Presence of water is necessary to form (H+ or OCL-) or HCL or HOCL bolds) That can affect litmus paper.

b) - Add dil HCL acid to each
- $BaSO_{3(s)}$ give effervescence and dissolves no rxn with BaSO4/ gives a ppt or doesn't dissolves. (or alternatives)
$BaSO^4$ dissolves in dil HCL while $BaSO_4$ doesn't dissolve
or $BaSO_3$ gives effervescence with HCL while $BaSO_4$ doesn't
or $BaSO_4$ forms a white ppt while BaSO3 doesn't

K.C.S.E 2012 CHEMISTRY
PAPER 2 MARKING SCHEME

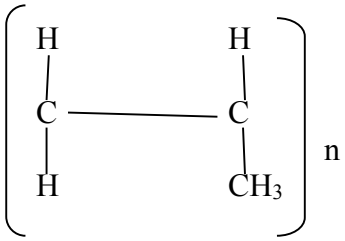
1. a)



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

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

ii)



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

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

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

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

R.M.M of $CH_3CH_2CH_2OH = 60$

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

2. a)
- Has the smallest atomic radius
- It is the most electronegative element in the periodic table
- Has the highest tendency to gain electrons
- Has the highest electron affinity.

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

ii) Covalent bond

c) i) Halogens

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

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

e) D_2O, D_2O_2

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

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

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

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

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

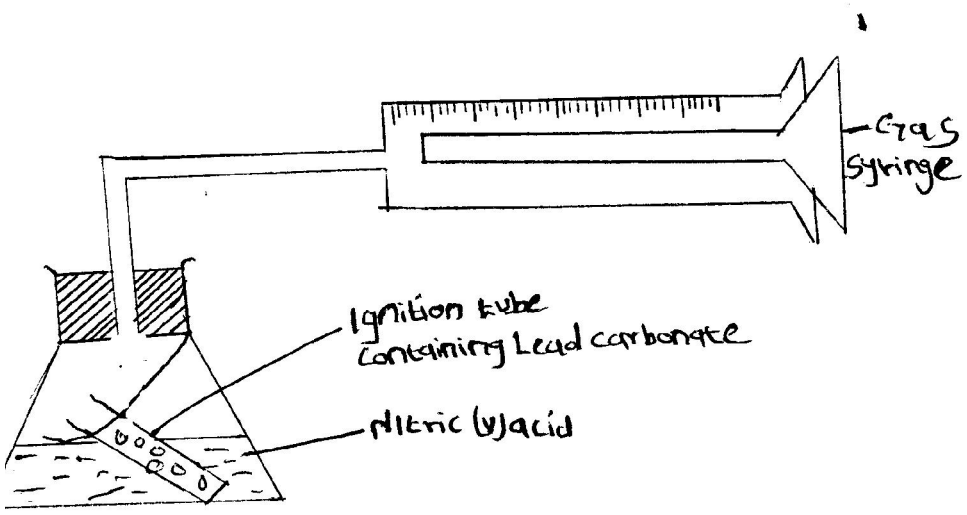
ii) $NH_{3(g)} + HNO_{3(aq)} \rightarrow NH_4NO_{3(aq)}$
Number of moles.
Of $NH_4NO_3 = \frac{4800}{80} \times 10 = 6 \times 10$
Number of moles $NH_3 = 6 \times 10^4$

Mass of ammonia in kg
$= \frac{6 \times 17 \times 10^4}{1000}$
$= 1020kg$

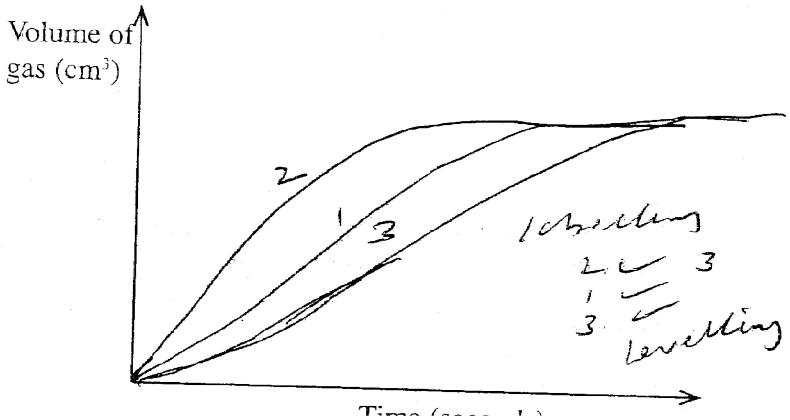
iii) Explosive – trinitroglycerine T.N.T
- Production of polymers
- Textiles and drugs

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

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



ii)



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

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

d) The intensity of yellow orange colour increases

- Equilibrium shifts to the left// backward rxn is favoured// rate of backward rxn is greater than that of forward rxn.

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

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

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

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

b) Number of coulombs = 0.3 x 30 x 0
= 540c.
Coulombs converted to faraday = $\frac{540}{96500}$
Faraday converted to moles $\frac{540}{96500} \times \frac{1}{4}$

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

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

6. a)i) O_2^-
ii) $CuCO_3$, $ZnSO_4$

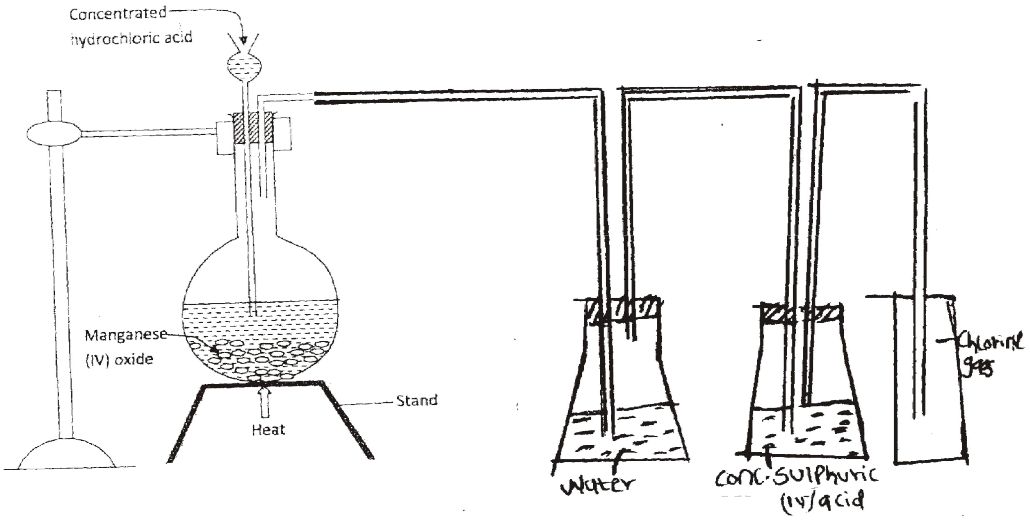
b) $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

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

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

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

7. a) i)



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

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

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

b)

Cl	O	0.02		0.07
0.71	1.12	0.02		0.02
35.5	16	1	:	3.5
0.71	1.12	2	:	7
35.5	16	Empirical formula Cl_2O_7		

c) - Manufacture of chloroform
- Manufacture of potassium
- Chlorate/ sodium chlorate
- Manufacture of bleaching agent
-Manufacture of tetrachloromethane
- Bleaching of wood pulp.
- Manufacture of polychloroethene (P.V.C)
- Manufacture of calcium chlorate (CaOCl2)

- Manufacture of plastics