2009 KCSE CHEMISTRY PAPER 2 MARKING SCHEME

1. (a) (i) $MnO_{2(g)} + 4HCl_{(aq)} \rightarrow MnCl_{2(g)} + Cl_{2(g)} + 2H_2O_{(l)}$ ✓ (1 mark)

(ii) $KMnO_4$ / $CaOCl_2$ / PbO_2 (1 mark)

(iii) - Passing it through a U-tube containing anhydrous Calcium Chloride (CaCl) ✓ ✓
- Passing Chlorine gas through concentrated Sulphuric acid in a flask
(2 marks)

(b) (i) Aluminium Chloride - $AlCl_3$ (1 mark)

(ii) $2Al_{(s)} + 3Cl_{2(g)} \rightarrow 2AlCl_{3(g)}$ (1 mark)

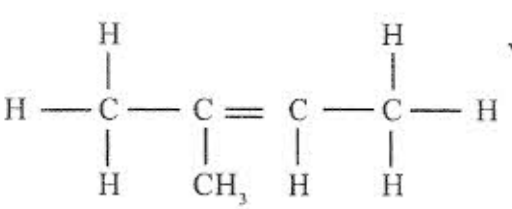
(iii) Moles of Al metal used $= \frac{0.84}{27}$ ✓ (3 marks
$= 0.0311$

Moles of Cl_2 gas $= 0.0311 \times \frac{3}{2}$ ✓
$= 0.047$

Vol. of Cl_2 gas $= 0.047 \times 24$ ✓½
$= 1.12dm^3$ ✓½ (Answer to 3 decimal places)

(iv) - Prevent moisture or water from entering the apparatus /absorbing ✓
- React with excess chlorine /prevent environmental pollution ✓
- Prevent hydrolysis of Aluminium Chloride (any 2 correct) (2 marks)

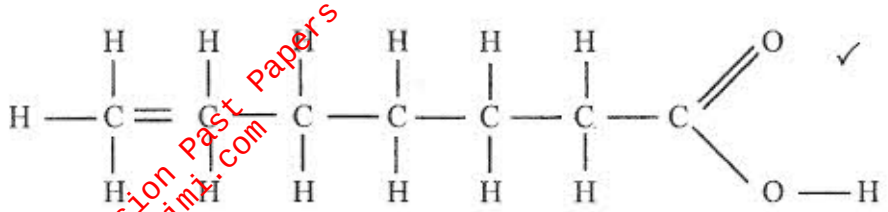
2. (a) (i) 2-methylbut -2-ene; (2 marks)

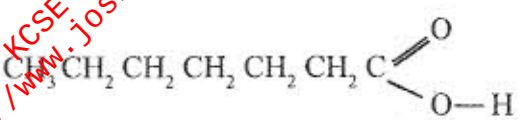


✓

$CH_3 = (CH_3)CH\ CH_3$

(ii) heptanoic acid





(b) - Determine the boiling points /temperature of the two alkanols. Hexanol has a higher boiling point /temperature
- Add equal amounts of water to each portion of alkanol and shake. For hexanol two layers of liquids are formed where for methanol a homogeneous solution or mixture is formed
- Determine the density of the two alkanols. Hexanol is denser than methanol
- Refractive index Hexanol has a higher refractive index

(2 marks)

(c) (i) Esterification accept condensation (1 mark)

(ii) Chloroethane / CH_3CH_2Cl / C_2H_5Cl (1 mark)

(iii) CH_3CH_2ONa / C_2H_5ONa (1 mark)

(iv) Hydrogen gas
High temperature (150° - 250°C) } 2marks for any 2 conditions
High pressure (200 - 250 Atm) } Tied to correct reagent
Nickel catalyst
Reject unspecified conditions (3 marks)

3. (i) (a) Cathode
$D^{2+}_{(l)} + 2e^- \rightarrow D_{(s)}$ (1 mark)

(b) anode
$2Br^-_{(l)} \rightarrow Br_{2(g)} + 2e^-$ (1 mark)

(ii) - Carbon Graphite
- It will not be attacked by /react with Bromine gas /Δ reacts with Bromine vapours

(2 marks)

(iii) Chlorine gas is poisonous /toxic gas ✓ (1 mark)

(iv) (a) Weigh the cathode before the start of the experiment. ✓
Weigh the cathode after the experiment /90 minutes ✓
Get the difference in weights ✓ (3 marks)

(b) $Q = It \Rightarrow Q = 0.4 \times 90 \times 60$ ✓½
$= 2160C$

1 mole of D = 96500

$$2.31 = \frac{2160 \times RAM}{2 \times 96500}$$ ✓½

$$RAM = \frac{2.31 \times 96500}{2160}$$ ✓½

$= 206.4$ ✓½

4. (a) (i) Channel /pump sea water into shallow ponds ✓½. Evaporation of water occur at the ponds ✓½. Sodium Chloride crystallises out ✓ (2 marks)

(ii) 1. $NH_{3(g)} + CO_{2(g)} + H_2O_{(l)} \rightarrow NH_4HCO_{3(aq)}$ ✓ (1 mark)

2. $NH_4HCO_{3(aq)} + NaCl_{(aq)} \rightarrow NaHCO_{2(s)} + NH_4Cl_{(aq)}$ ✓ (1 mark)

(iii) 1. Process I (2 marks)
Filtration ✓

2. Process II
Heating ✓

(iv) 1. (2 marks)
$Na_2CO_{3(s)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + CO_{2(g)} + H_2O_{(l)}$ ✓

Moles of $H_2SO_4 = \frac{40 \times 0.5}{1000}$ ✓½
$= 0.02$

Moles of Na_2CO_3 = Moles of $H_2SO_4 = 0.02$ ✓½

Mass of $Na_2CO_3 = 0.02 \times 106$

$2.12_{(g)}$ ✓

% age purity $= \left(\frac{2.12}{2.15} \times 100\right)\%$ ✓
$= 98.6\%$

2. (2 marks)

Mass of $Na_2CO_3 = 0.02 \times 106$ ✓½ ✓½
$= 2.12g$

% purity $= \left(\frac{2.12}{2.15} \times 100\right)\%$ ✓½
$= 98.6\%$ ✓½

(b) (2 marks)

- Used in textile industries
- Manufacture of glass
- Softening hard water
- Making of detergents
- Used in photography
- Making antiacid drugs
- In paper industries
- Manufacture sodium hydroxide
- As a food additive

5. (a) (i) (1 mark)

1. H Condensation ✓

2. G Melting ✓ (1 mark)

(ii) Iodine, Benzoic acid, Camphor, Dry ice /solid CO_2, Naphthalene ✓ (1 mark)

(iii) $H_2O_{(g)} \rightarrow H_2O_{(s)}$ ✓ (1mark)

(b) (i) 1. MN ✓½ (1 mark)
Van der Waals and Hydrogen bonding ✓½

2. RS
Van der Waals forces ✓ (1 mark)

(ii) 1. The separation distance is smaller during fusion than during vaporisation hence requires much lower energy than in vaporisation and vice versa
(2 marks)

2. Heating time NP is far much loss than heating time in QR / Heating time
(1mark)

(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 alot of heat / energy
- Hydrogen is renewable hence cannot be exhausted /used completely (3 marks)

(ii) - It can easily explode when burning /highly flammable unlike fossil fuels
- High cost of production unlike the fossils /fuels
- Expensive (1 mark)

6. (a) (2 marks)

Ion	Number of protons	Number of neutrons	Mass number	Electron arrangement
W	17 ✓½	20	37 ✓½	2.8.8
X^{4+}	14	14 ✓½	28	2.8 ✓½

(b) (i) Sodium burns with a yellow flame ✓½ and white yellow powder ✓½ /solid is formed. While copper burns with a green blue flame and black powder /solid is formed ✓½
(2 marks)

(ii) - Sodium darts on the surface of water /rapid effervescence /solution becomes pink immediately

- Magnesium sinks in water /slow effervescence /solution becomes pink gradually
(any 2 correct comparion 0; or 2 marks)

(c) Magnesium ✓ - It has a higher nuclear charge which pulls outer electrons more strongly ✓
(2 marks)

(d) (i) $^{230}_{92}U$ It is the most abundant ✓ (1 mark)

(ii) (2 marks)

$$\frac{0.01\times 234 + 0.72\times 235 + 238\times 99.27}{100} \checkmark$$

$$= \frac{(2.34 + 169.2 + 2362.26)}{100} \checkmark ½$$

$$= \frac{23797.80}{100}$$

$$= 237.978 \checkmark ½$$

(iii) (1 mark)

$$^{235}_{92}U \longrightarrow ^{231}_{90}Th + ^{4}_{2}He$$ ✓

(iv) Control thickness of paper ✓ (1 mark)

7. (a) Coke /coal /Charcoal /Carbon (1 mark)

(b) $C_{(s)} + CO_{2(g)} \rightarrow 2CO_{2(g)}$ ✓ (1 mark)

(c) The reaction between coke /coal and the hot air is highly exothermic ✓ ✓ (2 marks)

(d) Slag is immiscible with molten iron ✓ (1 mark)

(e) - Nitrogen (IV) Oxide gas forms acid rain which causes metallic materials and destroys vegetation in the environment ✓
- Nitrogen (IV) Oxide is poisonous causes Bronchitis /corrosion of upper respiratory tract /nausea /coughing / irritation of eyes and skin ✓ (2 marks)

✓

(f) (i) By passing /Blowing oxygen into molten iron which converts carbon into Carbon(IV)Oxide ✓ (2 marks)

(ii) To increase the tensile strength /making the iron /less brittle /making it more malleable /making it more ductile ✓ (1 mark)