FORM FOUR CLUSTER KCSE MODEL 3

CHEMISTRY PAPER 2 ANSWERS

SECTION1 (80 Marks)

1. (a) (i) Concentrated sulphuric acid;

   -Anhydrous calcium chloride;

   (ii) Finely divided iron catalyst

   (iii) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

   (iv) Temperatures of 500°C;

   - Pressure of about 200 atmospheres;

   (v) Recycling;

   (b) (i) Concentrated sulphuric (VI) acid;

   (ii) $Cu_{(s)} + 2H_2SO_{4(l)} \rightarrow CuSO_{4(aq)} + 2H_2O_{(l)} + SO_{2(g)}$;

   (iii) -The delivery tube from the reaction flask (round-bottomed) flask into the drying agent is not dipping into the drying agent; -The gas is denser than air hence cannot be collected by upward delivery;

   (iv) To dry the gas;

2. (a) Process: Cracking of alkanes;

   Catalyst:

   b) Conditions: Nickel catalyst; 450°C;

   Reagent: hydrogen;

   c) (i) Hydration;

   (ii) Water;

   iii)Heating;

   d) (i) Fermentation;

   (ii) Temperature of 350 C; absence of oxygen;

   (iii)

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + heat;$$

(e) (i) Table:

Step	Name	Reagents	Conditions
V	Oxidation	Acidified $KMnO_{4(aq)}$ / $K_2Cr_2O_{7(aq)}$;	Heating;
X	Esterification	Ethanol/ethanoic acid	Heating/warming

(ii) Tied to (e); depending on the reagents:

Acidified potassium manganate (VII): purple acidified potassium manganate (VII) turns colourless:

Acidified potassium dichromate (VI): orange acidified potassium dichromate (VI) turns green;

f) (i) (i) $C_2H_5OH + 2[0] \rightarrow CH_3COOH + H_2O_{(1)}$;

The oxidizing agent must appear on the arrow.

(ii) $C_2H_{4\,(g)} + Br_{2\,(aq)} \rightarrow CHBrCHBr$;

iii) $C_2H_5OH + CH_3COOH \rightarrow CH_3COOC_2H_5 + H_2O$;

(g) Brown bromine water is decolourised;

(h) (i) Addition / bromination;

(ii) Combustion;

(iii) Displacement / decomposition reaction;

(iv) Making polythene bags; lining of jackets; insulators

3. (a)

$$Al^{3+}{}_{(aq)} + 3e \rightarrow Al_{(s)};$$

$$Q = It;$$
$$= 3 \times 10 \times 60$$
$$= 1800C;$$

Molar mass of aluminium =27;

To discharge 1 mole of Al needs 3 x 96,500C;

$$3 \times 96{,}500C = 27g;$$

$$1{,}800C = \frac{1{,}800 \times 27}{3 \times 96{,}500} = 0.1678g;$$

(b) (i) Q; Q, P, R, S, and T;

ii) $T_{(s)} / T^{2+}{}_{(aq)} // Cu^{2+}{}_{(aq)} / Cu_{(s)}$;

iii) $E.m.f = E_{reduced} - E_{oxidised}$;

$$Thus +0.45V = +0.34V - (-\times)$$

$$Hence \times +0.34V = 0.45V;$$

$$\times = 0.45V - 0.34V$$

$$= +0.11V;$$

If the oxidation potential = +0.11;

Then the reduction potential = - 0.11V;

Accept any other correct working

(iv) $Cl_2 + 2KBr_{(aq)} \rightarrow 2KCl_{(aq)} + Br_2$;

(v)

$$Cl_{2_{(g)}} + 2NaBr_{(aq)} \rightarrow 2NaCl_{(aq)} + Br_{2(l)}$$

$$1000cm^3 = 0.02moles;$$

$$Thus\ 50cm^3 = \frac{50 \times 0.2}{1000} = 0.01moles;$$

Mole ratio of Cl2: KBr= 1:2 respectively;

Thus moles of chlorine = $\frac{1}{2} \times 0.1 = 0.005moles$

Using Molar gas volume:

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

$$0.005\ moles = \frac{0.005 \times 24{,}000}{1} = 0.12litre;$$

4. (a) Element A ;has 6 electrons in the outermost energy level; hence would gain 2 to form a stable ion;

(b) Amphoteric;

(c) Reactivity of E is higher than that of J // reactivity of J is lower than that of E; both react by gain of electrons;

E has a smaller atomic radius (dues to fewer energy levels) hence weaker nuclear attraction force leading to easier gain of electrons into the outermost energy level;

(d) $B_{(s)} + Cl_{2_{(g)}} \rightarrow BCl_{2_{(s)}}$;

(e) (i) -H has a smaller atomic radius than G // G has a larger atomic radius than H;

-For the same number of energy levels H has more protons than G and hence a stronger nuclear attraction to the outer electrons; leading to a smaller atomic radius; Owtte;

(ii) -B has a smaller atomic radius than H // H has a larger atomic radius than B;

-B has fewer energy levels than H;

(f) -Aqueous solution of oxide of B turns litmus solution blue;

-Aqueous solution of oxide of D turns litmus solution red;

(g) Element I; energy required to gain or lose electrons is same hence higher tendency to share electrons during reactions leading to covalent bonds;

(h) Ionic radius of J is higher than that of E; ion of J has more energy levels than ion of E;

5. I (i) Coke, calcium carbonate; haematite;

(ii) Carbon (IV) oxide, excess oxygen, excess carbon (II) oxide; nitrogen; argon;

(iii) X: slag; Y: molten iron;

(iv) $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$;

$SiO_{2(g)} + CaO_{(s)} \rightarrow CaSiO_{3(s)}$;

(v) (a) Calcium carbonate decomposes to give calcium oxide and carbon (IV) oxide; coke undergoes oxidation to form carbon (IV) oxide; the carbon (IV) oxide from both reactions undergo reduction in presence of coke torn form carbon (II) oxide;

(b)(i)

$$2Fe_2O_{3(s)} + 2CO_{(g)} \rightarrow 2Fe_{(s)} + 2CO_{2(g)};$$

(ii) Carbon; phosphorus; sulphur;

(c) (i) Blow air through the molten iron; the oxygen in the air oxidizes the carbon / sulphur / phosphorus into their respective gaseous oxides which escapes thus purifying the ore;

(ii) Cast iron is brittle unlike wrought iron; cast iron is harder than wrought iron; cast iron has more impurities (3%C, l% Si, 2%P) than wrought iron (0.1%C); wrought iron is malleable and can be welded or molded unlike cast iron;

II (a) Fe3+;

(b) Hydroxonium ion;

(c) Magnesium is more reactive than iron; so in presence of air and oxygen it undergoes corrosion / reacts with air and water at the expense of iron;

(d) Covalent; such that absence of ions means it will not participate in the redox reactions characteristic of rusting;

6. (a) (i) Heating;

(ii) I. Dilute nitric (V) acid;

II Oxygen gas;

III Nitric (V) acid and nitrous (III) acid;

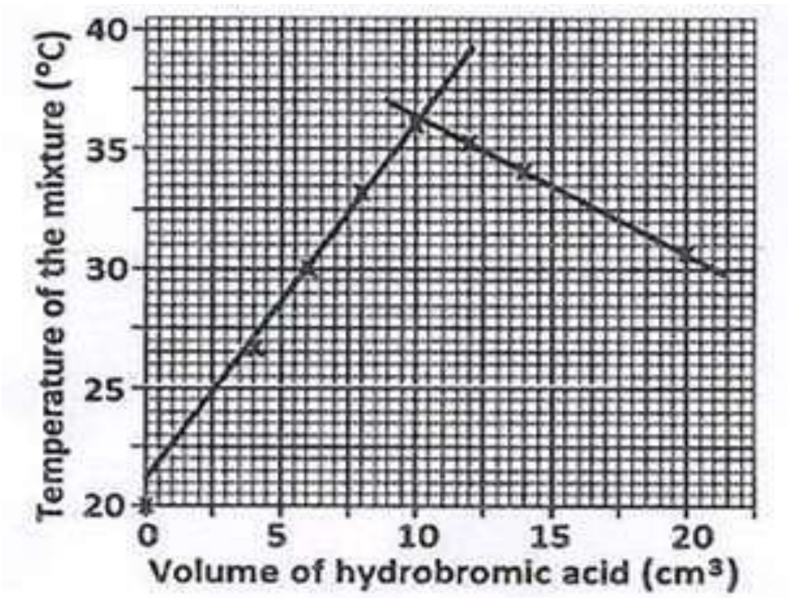
(iii) I. $[Zn(OH)_4]^{2-}$;

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

(b) (i). Formation of lead (II) sulphate which coats the surface of the lead (II) nitrate prevents further reaction with acid.

(ii) Potassium nitrate; sodium nitrate;

7. (a) Graph: Temperature of the mixture against volume of the acid.



(b) (i). 32.5°C;

(ii) Represents the end point of neutralization of hydrobromic acid by sodium hydroxide;

(iii) The temperature rose to the maximum due to production of heat during the neutralization reaction //reaction is exothermic; and then started dropping after completion of the reaction due to heat loss as the mixture cools to room temperature;

(c) (i). 10.0cm3;

$1000cm^3 \rightarrow 2\,moles;$

$Thus\ 20cm^3 \rightarrow \frac{20\times 2}{1000} = 0.04\,moles;$

(iii) Since mole ration = 1:1;

Moles of hydrobromic acid used = 0.04 moles;

(d) (i) Heat change= T

$= \frac{30.00}{1000}\times 4.18\times 9.2$

$= -1.15368\ ;\ kJ$

(ii) $0.04\,moles \rightarrow -1.15368\,kJ$

$$Thus\ 1\,mole \rightarrow \frac{1\times -1.15368}{0.04} = -28.842kJ\ per\ mole;$$