GEORGE

WAKISSHA JOINT MOCK EXAMINATIONS
MARKING GUIDE
Uganda Certificate of Education
UCE July/August 2023
CHEMISRTY 545/2

1. (a) (i) Components in steel are physically combined while those in Magnesium oxide are chemically combined.
   - Components in steel can be separated by physical means while elements in Magnesium oxide can be separated by chemical means.
   - Properties of steel are average of those of its components while in Magnesium oxide its properties are different from its components.
   - No energy is released/absorbed in formation of steel while energy is absorbed in formation of Magnesium oxide.
   - Steel has variable composition while that of Magnesium oxide is not variable.

   Any 2 correct (2marks) 05

   (ii) Using a magnet/Magnetic separation. *(½mark)*

   (b) (i) The indicator turns from orange to red. *(½mark)*

   - Ammonium chloride dissolves in water according to the equation.

   $$NH_4Cl_{(s)} + H_2O_{(l)} \longrightarrow NH_4OH_{(aq)} + HCl_{(aq)}$$

   The Hydrochloric acid formed is stronger than the ammonium hydroxide and therefore the resultant solution is acidic. *(2marks)*

   05

2. (a) (i) (31 – 15) = 16 neutrons. *(1mark)*

   (ii) 2 : 8 : 8 *(1mark)*

   (b) Group V or (V) rej. 5 *(½mark)*

   (c) Z_2O_3, covalent bond *(1½mark)*

   (d) Isotopy *(1mark)* 05

   05

3. (a) (i) Hydrogen *accept formula H_2* *(½mark)*

   (ii) $Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$ *(1½mark)*

   (iii) To speed up the reaction rate *(½mark)*
   Or Increase the rate of reaction 05

   (b) Nitric acid is a strong oxidizing agent *(1mark)*

   (c) Using anhydrous Copper (II) sulphate. When the product is added to white anhydrous copper (II) sulphate it turns to blue. *(1½mark)*

   05

4. (a) Amount of products formed per unit time OR Equivalent. (1mark)

(b) (a) - Presence of a catalyst
- Concentration of reactants.
- Temperature of reactants.

(2marks)

(i) $2H_2O_{2(l)} \xrightarrow{cap} 2H_2O_{(l)} + O_{2(g)}$ (1½mark)

(c) Sodium Peroxide (½mark)

05

5. (a) (i) % of oxygen = 100 – (43.40 + 11.32) = 45.28

Elements	Na	C	O
Moles	$\frac{43.40}{23}$	$\frac{11.32}{12}$	$\frac{45.28}{16}$
	1.89	0.94	2.83
Divide by smallest	$\frac{1.89}{0.94}$	$\frac{0.94}{0.94}$	$\frac{2.83}{0.94}$
Ratio	2 :	1 :	3

(02marks)

Empirical formula is Na_2CO_3

$(Na_2CO_3)_n = 106$

$46n + 12n + 48n = 106$

$106n = 106$

$n = 1$

Molecular formula is Na_2CO_3

(b) (i) ~~Blue~~ green precipitate (½mark)

(ii) $Cu^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow CuCO_{3(s)}$ (1½mark)

(c) $Zn(s) + CuCO_{3(s)} \rightarrow ZnCO_{3(s)} + Cu_{(s)}$ (1½mark)

05½

6. (a) (i) Sulphur dioxide (1mark)

(ii) Carbon dioxide (1mark)

(b) $2H^+_{(aq)} + CO^{2-}_{3(aq)} \rightarrow CO_{2(g)} + H_2O_{(l)}$ (1½mark)

(c) Rfm of $CaCO_3$

$40 + 12 + 16 \times 3$

$= 100$

If $22.4dm^3$ of CO_2 at Stp is evolved from 100g. (½mark)

$2gdm^3$

$0.224dm^3$ of CO_2

$\left(\frac{100}{22.4} \times 0.224\right)$

= 1g of $CaCO_3$ (½mark)

(½mark)

05

7. (a) (i) Zinc ✓ (½ma
(ii) Copper ✓ (½ma
05

(b) (i) $Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + 2e^-$ ✓ Accept $Zn_{(s)} - 2e^- \longrightarrow Zn^{2+}_{(aq)}$ (1ma
(ii) $Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$ ✓ Accept ⇌ (1ma

(c) Copper electrode. ✓ (2mar
Reason; If under goes reduction ✓ takes place / Copper is less reactive than Zinc

8. (a) This is the heat change when one ✓ mole of a substance is completely burnt in excess oxygen ✓ under standard conditions. ✓ Ignore. Req' 1. (1mar

(b) (i) Rfm. of CH_4 is (12 + 4) = 16 ✓ (½mark
890kJ are produced by 16g of CH_4 ✓ (½mark
5050kJ are produced by $\left(\frac{16}{890} \times 5050\right)$ ✓ 05 (½marks
Mass of CH_4 = 90.7865g ✓ Accept alt (1 mark

Alternative
moles of CH_4
890kJ are produced by 1 mole of CH_4
5050kJ are produced by $\left(\frac{5050}{890}\right)$ moles of CH_4
= 5.6741 moles
mass of CH_4
Molar mass of CH_4 = 12 + 4
= 16g ✓
mass of CH_4 = 16 × 5.674 moles
= 90.793g ✓

(ii) Ethane ✓ (½ mark
Has more Carbon atoms ✓ (1 marks)
05

9. (a) (i) $C_2H_5OH \xrightarrow[180^0C]{Conc\ H_2SO_4} H_2C = CH_{2(g)} + H_2O_{(l)}$ ✓ Accept $C_2H_{4(g)}$ (1mark)
Ethene ✓ Accept  05½ (½marks)

(ii) $C_6H_{12}O_6 \xrightarrow[180^0C\ 35^0C]{yeast} 2C_2H_5OH + 2CO_2(g)$ ✓ (1mark)
Ethanol ✓ Req': C_2H_6O (lack of functional group) (½marks)

(b) (i) Acidified potassium permanganate, turns colourless ✓ Accept Alkaline solution (Acidified potassium manganate(VII) solution) (1mark)
Accept Bromine liquid
(ii) $C_2H_5OH_{(g)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(g)}$ (1½mark)
05½

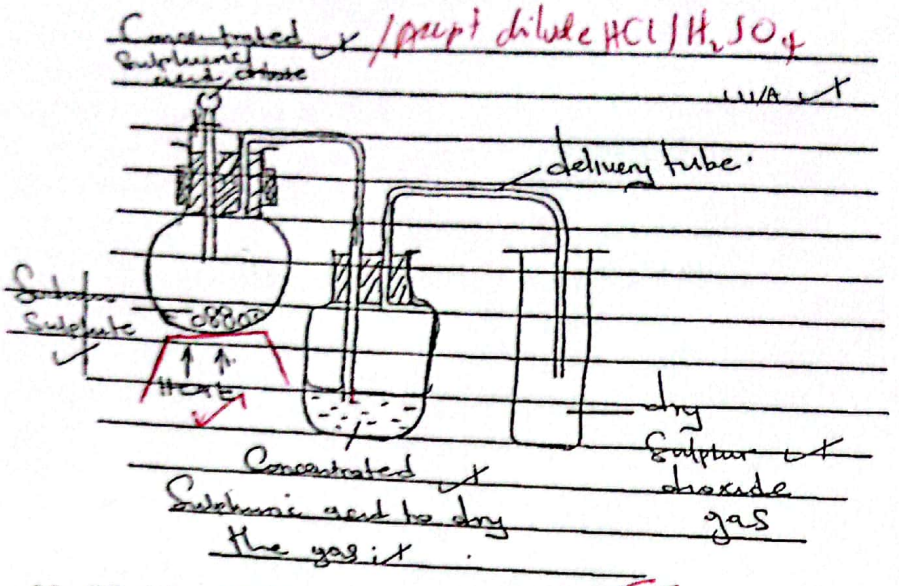
10. (a) Neutralization ✓ (1mark)

(b) (i) White precipitate ✓ Insoluble ✓ (1mark)
(ii) $Ag^+_{(aq)} + Cl^-_{(aq)} \longrightarrow AgCl_{(s)}$ ✓ (1mark)
Accept $AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow AgCl_{(s)} + NaNO_{3(aq)}$ (1½mark)

(c) Fractional crystallization ✓ Req' crystallization. (½marks)
04

SECTION B

11. (a) (i)



(3marks)

(ii) $Na_2SO_3(s) + H_2SO_{4(l)} \longrightarrow Na_2SO_{4(aq)} + SO_{2(g)} + H_2O_{(l)}$ (1½marks)

(b) (i) The red colour of the petal turns to white because it is bleached. (1mark)

$SO_{2(g)} + 2H_2O + Red \longrightarrow H_2SO_{4(aq)} + (Red + 2H)$ (1½marks)

white

(ii) A yellow deposit

$2H_2S_{(g)} + SO_{2(g)} \longrightarrow 2H_2O_{(l)} + 3S_{(s)}$ (1½marks)

(c) (i) $2SO_2 + O_2 \rightleftharpoons 2SO_{3(g)} + Heat$ (1mark)

$SO_{3(g)} + H_2SO_4 \longrightarrow H_2S_2O_{7(l)}$ (1mark)

$H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(aq)}$ (1mark)

Sulphur dioxide gas is reacted with pure oxygen in the presence of Vanadium (V) oxide catalyst at a temperature of about 400 - 500^{0}C, at high pressure to form sulphur trioxide.
The sulphur-trioxide is reacted with concentrated Sulphuric acid to form Oleum. Oleum is then diluted with a correct amount of water to form ordinally concentrated sulphuric acid.

12. (a) (i) To remove Oxygen gas (1mark)

(ii) To remove Carbon dioxide gas (1mark)

(iii) $2Cu_{(s)} + O_{2(g)} \longrightarrow 2CuO_{(s)}$ (1½marks)

$2NaOH_{(aq)} + CO_{2(g)} \longrightarrow Na_2CO_{3(aq)} + H_2O_{(l)}$ (1½marks)

(b) Nitrogen from air and hydrogen from natural gases are mixed in a ratio of 1 : 3 and then passed over finely divided Iron catalyst at 500^{0}C and 200 atmosphere.
Equation (4½marks)

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

Ammonia formed is either dissolved in water or liquidfied.

15

(c) (i) White precipitate soluble in excess to form a colourless solution (1½marks)

(ii) White precipitate is due to formation of Zinc hydroxide which is insoluble in water.

$Zn^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Zn(OH)_{2(s)}$ (4marks)

Colourless solution in excess is due to formation of a complex of tetra ammine Zinc (II) ions which is soluble. (1marks)

i.e

$Zn(OH)_{2(s)} + 4NH_{3(aq)} \longrightarrow [Zn(NH_3)_4]^{2+}_{(aq)} + 2OH^-_{(aq)}$ (1mark)

15

13. (a) Chlorine is produced by action of Potassium permanganate on concentrated hydrochloric acid. The gas is passed through ~~Calcium Oxide~~ fused anhydrous calcium chloride to dry and its then passed over **heated Iron filings in a combustion** tube.
The Iron filings glow red hot and **black** crystals of Iron (III) chloride will be deposited in the small bottle which acts as a condenser. (3marks)

Equation

$2Fe_{(s)} + 3Cl_{2(g)} \longrightarrow 2FeCl_{3(s)}$

(b) (i) A brown precipitate insoluble (1mark)

(ii) A white precipitate dissolves on warming and precipitates/reforms on cooling. (1½mark)

(c) (i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ (1mark)

$CO_{2(g)} + C_{(s)} \longrightarrow 2CO_{(g)}$ (1½mark)

(ii) $Fe_2O_{3(s)} + 3CO_{(g)} \rightleftharpoons 2Fe_{(s)} + 3CO_{2(g)}$ Accept (1½mark)

Accept $Fe_3O_{4(s)} + 4CO_{(g)} \rightleftharpoons 3Fe_{(s)} + 4CO_{2(g)}$

(iii) $CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$ (Ignore) (1mark)

$CaO_{(s)} + SiO_{2(l)} \longrightarrow CaSiO_{3(l)}$ (1½mark)

(d) Iron reacts with dilute hydrochloric acid forming Iron (II) Chloride.

$Fe_{(s)} + 2HCl_{aq} \longrightarrow FeCl_{2(aq)} + H_{2(g)}$ (1½mark)

Iron reacts with steam to form mixed oxide of tri Iron tetra oxide

Accept Iron(II, III) oxide

$Fe_{(s)} + 4H_2O_{(g)} \rightleftharpoons Fe_3O_{4(s)} + 4H_{2(g)}$ Accept (1½mark)

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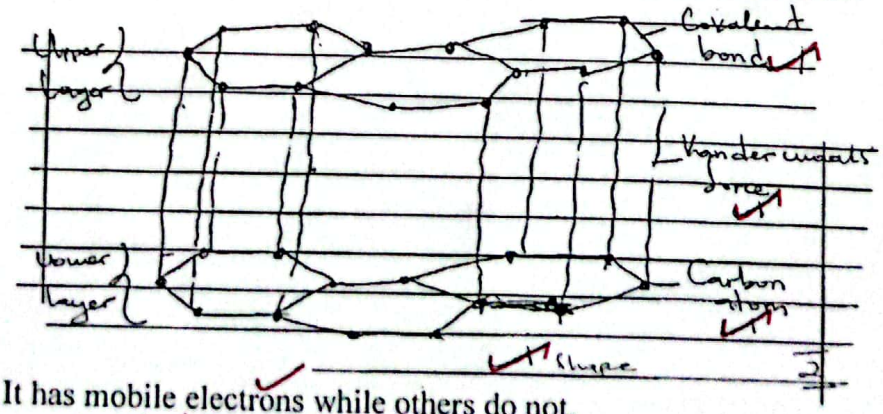
14. (a) (i) The different forms in which an element exists in the same state. (1mark)

(ii)



02

(iii) It has mobile electrons while others do not.

Accept delocalized electrons.

i) White precipitate is due to formation of insoluble Calcium Carbonate. *(½marks)*

$Ca(OH)_{2(aq)} + CO_{2(g)} \longrightarrow CaCO_{3(s)} + H_2O_{(l)}$ *(1½mark)*

and the colourless solution is due to the formation of soluble calcium hydrogen Carbonate. *(½marks)*

$CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)} \longrightarrow Ca(HCO_3)_{2(aq)}$ *(1½mark)*

Acc. combined equation But 1½ mks.

(ii) Carbon under limited Oxygen supply undergoes incomplete combustion to form carbon monoxide which competes for the available oxygen and hence suffocation. *(2½ marks)*

$2C + O_{2(g)} \longrightarrow 2CO_{(g)}$

(iii) Calcium Carbonate reacts with sulphuric acid to form an insoluble calcium sulphate that forms a protective coating around the Calcium carbonate and stops further reaction. *(3 marks)*

$CaCO_3(s) + H_2SO_4 \longrightarrow CaSO_4(s) + CO_{2(g)} + H_2O_{(l)}$

(iv) Ammonia gas being alkaline reacts with Sulpuric acid to form ammonium Sulphate. *(2 marks)*

$2NH_{3(g)} + H_2SO_{4(aq)} \longrightarrow (NH_4)_2SO_{4(aq)}$

15

END