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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)

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

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

(ii) - 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 rej. 5 (½mark)

(c) Z_2O_3, covalent bond (1½mark)

(d) Isotopy (1mark)

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

(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

- speed at which reactants are converted into products.
- Amount of reactants used up per unit time.

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

(b) (ii)
- Presence of a catalyst ✓
- Concentration of reactants. (any two)
- Temperature of reactants.

FeCl3

(i) $2H_2O_{2(l)} \longrightarrow 2H_2O_{(l)} + O_{2(g)}$ ✓✓ *(2marks)*

(c) Sodium Peroxide ✓, Potassium Chlorate · reject formula: *(1½mark)*

Accept: Potassium Permanganate; *(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 ✓

3 *(3marks)*

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 ✓ *(½mark)*

(b) (i) ~~Blue~~ Green precipitate ✓

(ii) $Cu^{2+}_{(aq)} + CO_3^{2-}(aq) \longrightarrow CuCO_{3(s)}$ ✓ (ignore states) *(1mark)*

(c) $Zn(s) + CuCO_{3(s)} \longrightarrow ZnCO_{3(s)} + Cu_{(s)}$ ✓ (ignore states) *(1mark)*

- Labor formular wrong

05½

6. (a) (i) Sulphur dioxide ✓ Accept formula. *(1mark)*

(ii) Carbon dioxide ✓ *(1mark)*

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

(c) Rfm of $CaCO_3$

$40 + 12 + 16 \times 3$

$= 100$ ✓ *(½mark)*

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

$0.224dm^3$ of CO_2

$\left(\frac{100}{22.4} \times 0.224\right)$ ✓ *(½mark)*

$= 0.1$g of $CaCO_3$ ✓ *(½mark)*

02

05

7. (a) (i) Zinc (½mark)
(ii) Copper (½mark)

(b) (i) $Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + 2e$ (1mark)
(ii) $Cu^{2+}_{(aq)} + 2e \longrightarrow Cu_{(s)}$ (1mark)

(c) Copper electrode. (2marks)
Reason; It under goes reduction

05

8. (a) This is the heat change when 1 mole of a substance is completely burnt in excess oxygen under standard conditions. (1mark)

(b) (i) Rfm. of CH_4 is $(12 + 4) = 16$ (½mark)

890kJ are produced by 16g of CH_4 (½mark)

5050kJ are produced by $\left(\frac{16}{890} \times 5050\right)$ (½marks)

Mass of CH_4 90.7865g (1 mark)

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

05

9. (a) (i) $C_2H_5OH_{(g)} \xrightarrow[180^0C]{\text{Conc } H_2SO_4} H_2C = CH_{2(g)} + H_2O_{(l)}$ (1mark)

Ethene (½marks)

(ii) $C_6H_{12}O_{6(aq)} \xrightarrow[35^0C]{\text{yeast}} 2C_2H_5OH + 2CO_2(g)$ (1mark)

Ethanol (½marks)

(b) (i) Acidified potassium permanganate, ~~turns colourless~~ solution (1mark)
Accept Bromine liquid

(ii) $C_2H_5OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(g)}$ (1½mark)

05½

10. (a) Neutralization (1mark)

(b) (i) White precipitate Insoluble (1mark)

(ii) $Ag^+_{(aq)} + Cl^-_{(aq)} \longrightarrow AgCl_{(s)}$ (1½mark)

Accept $AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow AgCl_{(s)} + NaNO_{3(aq)}$

(c) Fractional crystallization. (½marks)

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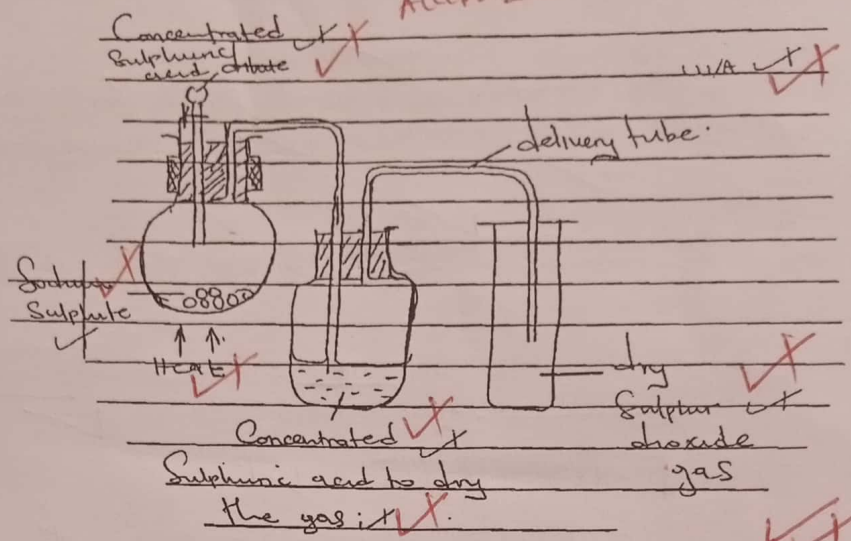
SECTION B

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)*

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

(ii) A yellow deposit

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

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

$SO_{3(g)} + H_2SO_{4(l)} \longrightarrow H_2S_2O_{7(l)}$ *(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.

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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. *(4½marks)*

Equation

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

Ammonia formed is either dissolved in water or liquidfied.

(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.

$Zn^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Zn(OH)_{2(s)}$ (ignore states) *(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 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 *(1mark)*

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

(c) (i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ *(½mark)*

$CO_{2(g)} + C_{(s)} \longrightarrow 2CO_{(g)}$ *(½mark)*

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

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

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

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

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

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

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

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

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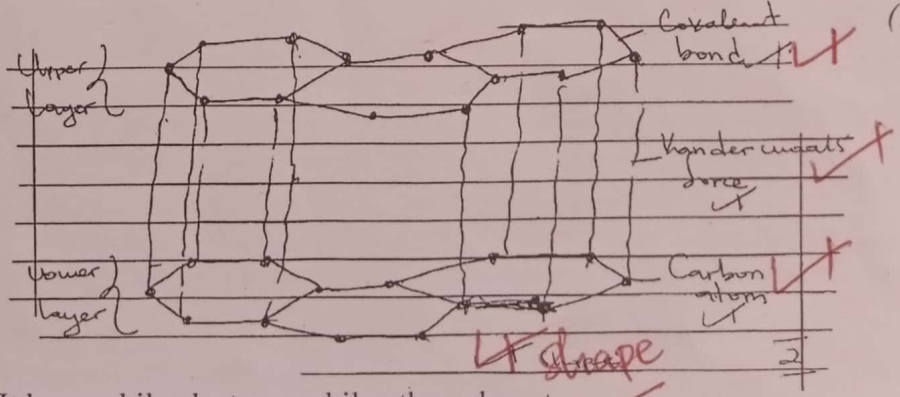
14. (a) (i) The different forms in which an element exists in the same state. *(1mark)*

(ii)



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

- Free/mobile electrons.
- Delocalized electrons.

(b) (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

$Ca(OH)_{2(aq)} + 2CO_{2(g)} \longrightarrow Ca(HCO_3)_{2(aq)}$

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

$2C_{(s)} + O_{2(g)} \longrightarrow 2CO_{(g)}$ Ignore states;

(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)*

$CaCO_3(s) + H_2SO_{4(aq)} \longrightarrow CaSO_4(s) + CO_{2(g)} + H_2O_{(l)}$

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

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

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END