SUGGESTED MARKING GUIDE ✓

P525/1
Chemistry
Paper 1
July - August 2023
2¾ hours

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS - 2023

NAME.....

INDEX NO..... SIGNATURE.....

UGANDA ADVANCED CERTIFICATE OF EDUCATION

Chemistry

Paper 1

2 hour 45 minutes

Answer all questions in Section A and **any six in Section B**.

All questions must be answered in spaces provided.

Illustrate your answers with equations where applicable.Molar gas constant, R=8.314jk^{-1}mol^{-1}

Molar volume for a gas at s.t.p is 22400cm^{3}Standard temperature =273k

Standard pressure =101325 Nm^{-2}

FOR EXAMINERS USE ONLY																	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
04	05	04½	05	05½	05½	05½	05½	05½	09	09	09	09	09	09	09	09	

SECTION A (46 marks)

1. (a) The following scheme is part of the radioactive decay of thorium.

$$^{234}_{90}Th \longrightarrow {}^{234}_{91}Pa \longrightarrow Y + a$$

(i) Identify the particle emitted in the first stage. (½ marks)

$^{0}_{-1}e$ ✓ (01/2) Accept beta particle

(ii) State the atomic number and the atomic mass of *Y*. (1 mark)

Atomic number = 88 ✓ and atomic mass = 230 ✓ (01)

(b) The activity of $^{234}_{90}Th$ reduced by 80% in 160 days. Determine the time it would take the activity of Thorium to reduce to half. (2½ marks)

$\ln\left(\frac{N_0}{N_t}\right) = \lambda t$ ✓

$\lambda = \frac{\ln\left(\frac{100}{100-80}\right)}{160}$ ✓

$= 1.005898 \times 10^{-2}\ day^{-1}$

Rej: without units

$t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$ (02½)

$= \frac{\ln 2}{1.005898 \times 10^{-2}}$ ✓

$= 69\ days$ ✓

Accept let N_0 be $y \Rightarrow N_t = \frac{1}{2}y$

$\ln\left(\frac{y}{0.5y}\right) = (1.005898 \times 10^{-2})t$ ✓

$t = \frac{\ln 2}{1.005898 \times 10^{-2}} = 69\ days$

2. (a) Methyl benzene reacts with chlorine to form 2-chloromethylbenzene. State the condition for the reaction. (1 mark)

Presence of a halogen carrier, like ~~the~~ anhydrous aluminium chloride (01)

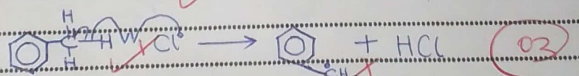
(b) Under a different condition the product is phenylchloromethane instead of chloromethyl benzene.

(i) State the condition for the reaction. (1 mark)

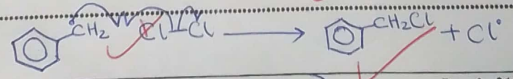
Ultraviolet light (01) Accept sunlight

(ii) Write the acceptable mechanism for the reaction. (3 marks)

$Cl_2 \longrightarrow 2Cl^{\bullet}$ ✓



$+ HCl$ (03)



$(Cl^{\bullet} + Cl^{\bullet} \longrightarrow Cl_2)$

3. Write equation to show the reaction between aqueous sodium hydroxide and the following oxides:

(a). Tin (II) oxide. (1½ marks)

$SnO_{(s)} + 2\bar{O}H_{(aq)} \longrightarrow SnO_2^{2-}{}_{(aq)} + H_2O_{(l)}$

OR $SnO_{(s)} + 2\bar{O}H_{(aq)} + H_2O_{(l)} \longrightarrow [Sn(OH)_4]^{2-}{}_{(aq)}$

(b) Silicon (IV) oxide. (1½ marks)

$SiO_{2(s)} + 2\bar{O}H_{(aq)} \longrightarrow SiO_3^{2-}{}_{(aq)} + H_2O_{(l)}$

(c) Trilead tetraoxide. (1½ marks)

$Pb_3O_{4(s)} + 6\bar{O}H_{(aq)} \longrightarrow 2PbO_2^{2-}{}_{(aq)} + PbO_3^{2-}{}_{(aq)} + 3H_2O_{(l)}$

OR $Pb_3O_{4(s)} + 6\bar{O}H_{(aq)} + 4H_2O_{(l)} \longrightarrow 2Pb(OH)_4^{2-}{}_{(aq)} + Pb(OH)_6^{2-}{}_{(aq)}$

4. Potassium dichromate (VI) is used as a primary standard in volumetric analysis.

(a) State **two** reasons why potassium dichromate (VI) is used as a primary standard. (2 marks)

Accept
- Has fairly high Rmm
- Readily soluble at r.t
- Easily obtained in pure state

It is not affected by air

It oxidises a wide range of substance

(b) Name **one** substance that can be standardised using potassium dichromate (VI). (½ mark)

Accept
- Sodium sulphite solution
- Sodium oxalate solution
- Potassium iodide solution (KCl, KBr)

Hydrogen peroxide solution

(c) To acidified potassium dichromate (VI) solution, hydrogen peroxide solution was added.

(i) State what was observed. (1 mark)

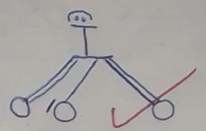
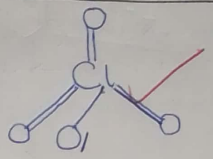
An orange solution turns to a green solution and bubbles of a colourless gas

(ii) Write the ionic equation for the reaction. (1½ marks)

$Cr_2O_7^{2-}{}_{(aq)} + 3H_2O_{2(aq)} + 8H^+{}_{(aq)} \longrightarrow 2Cr^{3+}{}_{(aq)} + 3O_{2(g)} + 7H_2O_{(l)}$

5. (a) Draw the structure and name the shapes of the following species. (3 marks)

Accept

Species	Structure	Shape
(i) IO_3^-		Trigonal pyramidal
(ii) ClO_4^-		Tetrahedral

03

(b) To the aqueous solution of the species from (a) (i), an acidified solution of potassium iodide was added.

(i) State what was observed. (1 mark)

Colourless solution turns to a brown solution ✓

(ii) Write equation for the reaction that took place. (1½ marks)

$2IO_{3(aq)}^- + 10I_{(aq)}^- + 12H_{(aq)}^+ \rightarrow 6I_{2(aq)} + 6H_2O_{(l)}$ ✓✓ ½

6. (a) Phenylamine hydrochloride, $C_6H_5NH_3Cl$, undergoes hydrolysis when dissolved in water.

Accept

Write an equation for the hydrolysis reaction. (1½ marks)

$C_6H_5\overset{+}{N}H_{2(aq)} + H_2O_{(l)} \rightleftharpoons C_6H_5NH_{2(aq)} + H_3O^+_{(aq)}$ ✓✓ ½

(b) A 0.02M solution of phenylamine hydrochloride has a pH of 3.4. Calculate;

(i) The molar concentration of the hydrogen ions in the solution. (2 marks)

$pH = -\log_{10}[H^+]$ ✓

$3.4 = -\log[H^+]$

$[H^+] = 10^{-3.4}$ ✓

$= 3.981 \times 10^{-4}$ moldm^{-3} ✓ ½

(ii) the hydrolysis constant, *Kh*, of phenylamine hydrochloride. (2½ marks)

$K_h = [C_6H_5NH_2][H_3O^+]$ / $[C_6H_5\overset{+}{N}H_3]$

At equilibrium, $[C_6H_5NH_2] = [H_3O^+]$

$K_h = \frac{[H_3O^+]^2}{[C_6H_5\overset{+}{N}H_3]}$

$= \frac{(3.981\times10^{-4})^2}{0.02} = 7.924\times10^{-6}$ mol dm^{-3}

7. 1.18g of compound **Z**, on vapourisation occupied 300cm^3 at s.t.p.

(a) Calculate the relative molecular mass of **Z**. (1½ marks)

Alternatively: $M_r = \frac{mRT}{PV}$

300cm^3 are occupied by 1.18g of Z

22400 cm^3 are occupied by $\frac{1.18\times22400}{300}$ g

$= \frac{1.18\times8.314\times273}{101325\times300\times10^{-6}}$

$= 88.1$

Ref: If units put $= 88.1$

(b) The empirical formula of **Z** is C_2H_4O.

(i) Determine the molecular formula of **Z**. (1½ marks)

$(C_2H_4O)_n = 88.1$

$(12\times2 + 4 + 16)n = 88.1$

$n = \frac{88.1}{44}$

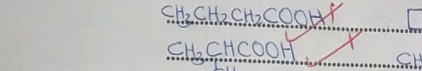
$= 2$

∴ Molecular formula of Z is $C_4H_8O_2$

(ii) Write the structural formulae of the possible isomers of **Z**. (2 marks)

$CH_3CH_2CH_2COOH$

$CH_3CHCOOH$ (CH$_3$ branch)



$HOCH_2C{=}CHCH_2OH$ (H)

$CH_3C{=}CCH_2OH$ (CH$_3$, H, OH)

(c) Compound **Z** reacts with sodium carbonate to produce a gas that turns lime water milky. Identify **Z**. (½ marks)

Accept any carboxylic acid from the isomers written above

$CH_3CH_2CH_2COOH$

8. Using equations show the following conversion can be carried out:

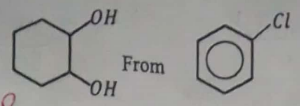
(a) $CH_3CH_2\underset{CH_3}{\overset{OH}{C}}=NOH$ from $CH_3\overset{OH}{C}HCH_3$ (2½ marks)

$CH_3\overset{OH}{C}HCH_3 \xrightarrow[H_2SO_4]{Cr_2O_7^{2-}/H^+} CH_3\overset{O}{C}CH_3 \xrightarrow[2)\ \text{Aqueous } NH_4Cl]{1)\ CH_3CH_2MgBr,\ \text{dry ether}} CH_3CH_2\underset{OH}{\overset{CH_3}{C}}CH_3$

$CH_3CH_2\underset{CH_3}{\overset{OH}{C}}CH_3 \xrightarrow{conc\ H_2SO_4,\ 180^\circ C} CH_3CH_2\overset{CH_3}{C}{=}CH_2$

$CH_3CH_2\overset{CH_3}{C}{=}CH_2 \xrightarrow[2)\ Zn/CH_3COOH/H_2O]{1)\ O_3/CCl_4,\ <20^\circ C} CH_3CH_2\overset{O}{C}CH_3$

$CH_3CH_2\overset{O}{C}CH_3 \xrightarrow{NH_2OH/H^+} CH_3CH_2\underset{CH_3}{\overset{NOH}{C}}$

(b).  From (3 marks)

Reject without (aq)

$NaOH_{(s)}$ OR $NaOH_{(aq)}$ / 360°C, 200 atm

H_2 / Ni catalyst / 200°C

$NaOH_{(aq)}$ / heat

180°C Conc H_2SO_4

Dilute HCl

H_2 / Ni / 200°C

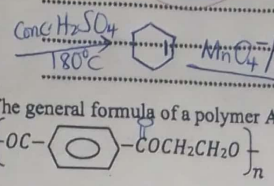
Conc H_2SO_4 / 180°C

MnO_4^- / $OH^-_{(aq)}$

MnO_4^- / $OH^-_{(aq)}$

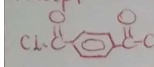
Reject: Heat

9. The general formula of a polymer A is

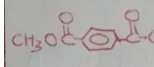


(a) Write the formula and names of the monomer(s) of A. (3 marks)

Accept



Benzene-1,4-dioyldichloride



Dimethylbenzene-1,4-dicarboxylate

$HOOC-C_6H_4-COOH$; $HOCH_2CH_2OH$

Benzene-1,4-dioic acid Ethane-1,2-diol 02

(b) Name the type of polymerization by which A is formed. (1 mark)

Condensation polymerization 01

Rej: Condesertion or condensation (Any other wrong spelling)

(c) Explain why depression freezing point method is not convenient for determination of the molecular mass of A. (1½ marks)

Polymer A has a very high relative molecular mass, it produces very few particles in ~~solut~~ the dilute solution. Since freezing point depression is directly proportional to number of particles in solution, the depression in freezing point caused is very small which is difficult to measure from the thermometer. 1½

SECTION B

10. The exothermic reaction between nitrogen and hydrogen takes place according to the equation.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(a) Write the expression for the equilibrium constant, Kc, for the forward reaction. (1 mark)

$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$ ✓

(b) At 500^0C, the equilibrium concentration of hydrogen is 0.250 $moldm^{-3}$ and nitrogen is 2.7 $moldm^{-3}$.

Calculate the equilibrium concentration of ammonia at 500^0C.

($kc = 6.0 \times 10^{-2} dm^{-6} mol^{-2}$) (3 marks)

$[NH_3] = \sqrt{6.0 \times 10^{-2} (0.25)^3 \times 2.7}$ ✓

$= 0.0503\ moldm^{-3}$ ✓ 03

(c) State what would happen to;

(i) the value of Kc and equilibrium position if the pressure of the system was reduced. (1 mark)

It would shift the equilibrium position from right to left ✗ but value of Kc is unchanged ✓ 01

(ii) the volume of ammonia, if nitrogen was constantly removed from reaction mixture. (½ mark)

~~It would shift the equilibrium position from~~ The volume of ammonia would decrease ✓ 01

(d) Explain the effect of adding helium to the equilibrium mixture at constant pressure.

(2½ marks)

The equilibrium position shifts to the left where ammonia dissociates into nitrogen and hydrogen gas without change in the equilibrium constant value but the rate of attainment of equilibrium reduces since reactant molecules are far apart which reduces the frequency of effective collision. 03

11. Complete the following reactions and write a mechanism.

(a) $CH_3CH_2Br \xrightarrow[heat]{KOH/CH_3CH_2OH} (CH_3CH_2)_2O + KBr$ (2½ marks)

only accept product if the mechanism is correct

$KOH + CH_3CH_2OH \longrightarrow CH_3CH_2OK + H_2O$ 2½

$CH_3CH_2OK \longrightarrow CH_3CH_2O^- + K^+$

$CH_3CH_2Br + CH_3CH_2O^- \longrightarrow CH_3CH_2OCH_2CH_3 + Br^-$

@ $(K^+ + Br^- \longrightarrow KBr)$

(b) CH_3-C$_6$H$_4$-$OH + CH_3COBr \xrightarrow{NaOH(aq)}$ (3 marks)

H_3C-C$_6$H$_4$-$OH + NaOH \longrightarrow H_3C$-C$_6H_4$-$ONa + H_2O$ 3½

H_3C-C$_6$H$_4$-$O^- + CH_3CBr(CH_3) \longrightarrow H_3C$-C$_6H_4$-$O$-$C(CH_3)_2$-$Br \longrightarrow H_3C$-C$_6H_4$-$O$-$C(=O)CH_3 + Br^-$

(c) $CH_3CH_2CH_2OH \xrightarrow[200^oC]{Conc.H_3PO_4} CH_3CH=CH_2 + H_2O$ (3½ marks)

$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-$

$CH_3CH_2CH_2OH \xrightarrow{-H_2O} CH_3\overset{+}{C}HCH_3 \longrightarrow CH_3CH_2\overset{+}{C}H_2$ 03

hydride shift

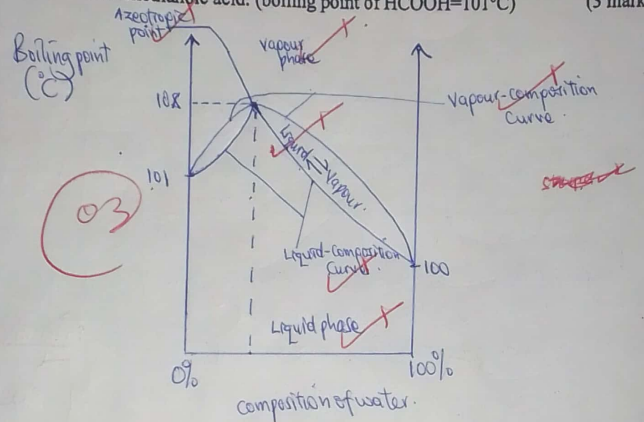
$CH_3\overset{+}{C}HCH_3 + H_2PO_4^- \longrightarrow CH_3CH=CH_2 + H_3PO_4$

12. Methanoic acid, $HCOOH$ and water are miscible in all proportions. They form a maximum boiling point mixture containing 78% methanoic acid that boils at 108°C.

(a) (i) Define the term **maximum boiling point mixture.** (1 mark)

Is the liquid mixture which at constant pressure boils at a constant temperature higher than that of each pure component forming vapour having the same composition as the liquid mixture. 01

(ii) Sketch a labelled boiling point – composition diagram for mixtures of water and methanoic acid. (boiling point of HCOOH=101°C) (3 marks)



03

(b) Explain briefly why methanoic acid and water form a maximum boiling point mixture. (3 marks)

Pure molecules of water and pure molecules of methanoic acid interact via intermolecular hydrogen bonds. 03

When mixed, ion–ion dipole moments are formed between unlike molecules in solution which are stronger than the intermolecular hydrogen bonds in pure components

This reduces the escaping tendency of molecules from solution into vapour, lowering the vapour pressure of solution hence raising the boiling point of solution higher than that of pure components.

(c) Describe what would happen when a mixture containing 40% methanoic acid is distilled. (2 marks)

When a liquid mixture containing 40% methanoic acid is heated, it boils at constant temperature forming vapour richer in the more volatile component, water.
Cooling the vapour yields a liquid having the same composition as the vapour
Repeated heating and cooling finally yields pure water in the distillate and azeotropic mixture in the residue

Accept: ...pure

13. Name a reagent that can be used to distinguish the following species, in each case state what would be observed if the named reagent is separately reacted with each member of the pair.

(a) $Cr_2O_7^{2-}$ and CrO_4^{2-} (3 marks)

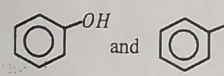
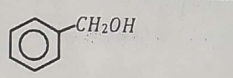
Reagent: Dilute sulphuric acid
With $Cr_2O_7^{2-}$: No observable change
With CrO_4^{2-}: Yellow solution turns to an orange solution

Accept: ...sodium hydroxide solution
: Orange solution turns to a yellow solution
: No observable change

(b) Ba^{2+} and Ca^{2+} (3 marks)

Reagent: Ammonium oxalate solution followed by ethanoic acid
With Ba^{2+}: White precipitate soluble in acid
With Ca^{2+}: White precipitate insoluble in acid

Potassium chromate solution followed by ethanoic acid
: Yellow precipitate insoluble in acid
: Yellow precipitate soluble in acid.

(c)  and  (3 marks)

Reagent: Neutral iron(III) chloride solution
With  : Purple / violet coloration
With  : NO observable change

14. The following half-cell reactions are given

	E^{θ}/V
$Cu^{2+}(aq) + 2e \rightarrow Cu(s)$	+0.34
$I_2(aq) + 2e \rightarrow 2I^-(aq)$	+0.54
$H_2O_2(aq) + 2e + 2H^+(aq) \rightarrow 2H_2O_{(l)}$	+1.77
$Cl_2(g) + 2e \rightarrow 2Cl^-(aq)$	+1.36

(a) (i) Write the cell notation for the cell made up of the half cells consisting of iodide ions and acidified hydrogen peroxide. (1½ marks)

$Pt_{(s)} / I^-_{(aq)}, I_{2(aq)} // H_2O_{2(aq)}, H^+_{(aq)}, H_2O_{(l)} / Pt_{(s)}$ 1½

(ii) Write the overall equation for the reaction. (1 mark)

$2I^-_{(aq)} + H_2O_{2(aq)} + 2H^+_{(aq)} \rightarrow I_{2(aq)} + 2H_2O_{(l)}$ 1

(iii) Calculate the e.m.f of the cell and state whether the reaction is feasible or not. (2½ marks)

$E^{\theta}_{cell} = E^{\theta}_{right} - E^{\theta}_{left}$ ✓

$= (1.77 - 0.54) = +1.23V$ ✓

2½ The reaction is feasible because emf of the cell is positive ✓

(b) (i) Will the iodide ions reduce copper (II) ions to copper solid? Give a reason for your answer. (1½ marks)

Iodide ions will not reduce Copper(II) ions to copper because emf of iodine half cell is less positive than that of copper half cell ✓ 1½

Accept

$E^{\theta} = 0.34 - 0.54$

$= -0.20V$ (emf of cell is negative)

(ii) Explain whether hydrochloric acid is suitable for acidifying hydrogen peroxide

Chloride ions in hydrochloric acid are ~~reduce~~ oxidized ✓ by hydrogen peroxide to chlorine, which is also an oxidizing agent. Therefore there will be Competition for the oxidizing agent ✓ 2½

$H_2O_{2(aq)} + 2Cl^-_{(aq)} + 2H^+_{(aq)} \rightarrow Cl_{2(g)} + 2H_2O_{(l)}$ ✓

15. (a) Copper (II) carbonate occurs as a basic carbonate.

Write equation for the reaction to show how this carbonate can be prepared.

(1½ marks)

$2Cu^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} + 2OH^-_{(aq)} \rightarrow CuCO_3 \cdot Cu(OH)_{2(s)}$ 1½

(b) Copper (II) carbonate was dissolved in warm nitric acid and to the resultant solution, potassium iodide solution was added.

(i) State what was observed. (½ mark)

Block mark: A white precipitate in a brown solution. ½

(ii) Write equation for the reaction that took place. (½mark)

$2Cu^{2+}_{(aq)} + 4I^-_{(aq)} \rightarrow Cu_2I_{2(s)} + I_{2(aq)}$ 1½

(c) To the mixture from (b) above, sodium thiosulphate solution was added.

(i) State what was observed. (½ mark)

Block mark: Brown solution turns to colourless solution. ½

(ii) Write equation for the reaction that took place. (1½ mark)

$2S_2O_3^{2-}{}_{(aq)} + I_{2(aq)} \rightarrow S_4O_6^{2-}{}_{(aq)} + 2I^-_{(aq)}$ 1½

(d) 0.8g of copper ore was reacted with dilute sulphiric acid and the resultant solution diluted to 250cm^3 with distilled water. To 30cm^3 of this solution, excess 0.2M potassium iodide was added. The liberated iodine required 23.5cm^3 of 0.05M solution of sodium thiosulphate for complete reaction.

Determine the percentage of copper in the ore. (3½ marks)

moles of $K_2C_2O_3 = \frac{23.5 \times 0.05}{1000}$

$= 0.001175$ moles

mole ratio of $I_2 : S_2O_3^{2-} = 1:2$

moles of $I_2 = \frac{1}{2}(0.001175)$

$= 5.875 \times 10^{-4}$ moles

mole ratio of $I_2 : Cu^{2+} = 1:2$

moles of $Cu^{2+} = (2 \times 5.875 \times 10^{-4})$

$= 0.001175$ moles

30cm^3 of solution contain 0.001175 moles of Cu^{2+}

250cm^3 of solution contain $\frac{0.001175 \times 250}{30}$

$= 9.7917 \times 10^{-3}$ mole

mass of $Cu^{2+} = (63.5 \times 9.7917 \times 10^{-3})$

$= 0.6218$g

Percentage of Copper $= \frac{0.6218}{0.8} \times 100$

$= 77.73\%$

16. (a) For each of the following species, determine the oxidation state of manganese.

(i) MnO_4^- (1 mark)

Let oxidation state of Mn be x

$x + 4(-2) = -1$ ⇒ $x = +7$

$x = -1 + 8$

(ii) MnO_4^{2-} (1 mark)

Let oxidation state $x + 4(-2) = -2$

$x = -2 + 8$

$\Rightarrow x = +6$

(b) State what is observed and write equation for the reaction that occurs when;

(i) acidified hydrogen peroxide is added to potassium manganate (VII) solution. (2½ marks)

Observation:

Purple solution turns to colourless solution and bubbles of colourless gas.

Equation:

$2MnO_4^-(aq) + 5H_2O_2(aq) + 6H^+(aq) \longrightarrow 2Mn^{2+}(aq) + 5O_2(g) + 8H_2O(l)$

(ii) dilute sulphiric acid is added to a solution of potassium manganate (VI) solution. (2½ marks)

Observation

Green solution turns to purple solution and brown solid is formed.

Equation

$3MnO_4^{2-}(aq) + 4H^+(aq) \longrightarrow 2MnO_4^-(aq) + MnO_2(s) + 2H_2O(l)$

(c) Compare the reaction of manganese (II) sulphate and magnesium sulphate with excess sodium hydroxide solution when exposed to air. (2 marks)

02

Both magnesium sulphate and manganese(II) sulphate react with excess sodium hydroxide solution precipitating magnesium hydroxide and manganese(II) hydroxide respectively

Here $X^{2+}_{(aq)} + 2OH_{(aq)} \longrightarrow X(OH)_{2(s)}$ $(X = Mg, Mn)$

However, manganese(II) hydroxide undergoes aerial oxidation to form hydrated manganese(IV)oxide

$2Mn(OH)_{2(s)} + 3O_{2(g)} \longrightarrow 2MnO_2 + H_2O_{(s)}$

17. 0.155g of an organic compound W when burnt in oxygen gave 0.22g of carbon dioxide and 0.135g of water.

(a) Determine the empirical formula of W. (3½ marks)

Mass of $C = \frac{0.22 \times 12}{44} = 0.06g$

Mass of $H_2 = \frac{2}{18} \times 0.135 = 0.015g$

mass of $O_2 = 0.155 - (0.06 + 0.015)$

$= 0.08g$

Element	C	H	O
moles	$\frac{0.06}{12}$	$\frac{0.015}{1}$	$\frac{0.08}{16}$
	$= 0.005$	0.015	0.005
mole ratio	$\frac{0.005}{0.005}$	$\frac{0.015}{0.005}$	$\frac{0.005}{0.005}$
	$= 1$	3	1

Empirical formula of W is CH_2O

3½

(b) When vapourised at 127°C, 0.225g of W occupied 111.11cm³ at 760mmHg.

(i) Calculate the molecular mass of W. (2½ marks)

$M_r = \frac{mRT}{PV}$

$= \frac{0.225 \times 8.314 (127 + 273)}{101325 \times 111.11 \times 10^{-6}}$

$= 66.5g$

2½

(ii) Determine the molecular formula of W. (1½ marks)

$(CH_2O)_n = 66.5$

$(12 + 2 + 16)n = 66.5$

$n = \frac{66.5}{31}$

$n = 2$

∴ Molecular formula of W is $C_2H_6O_2$

1½

(c) W reacts with acidified potassium dichromate (VI) solution to form ethane -1, 2-dioic acid. Write the formula and IUPAC name of W. (1½ marks)

$HOCH_2CH_2OH$; Ethane-1,2-diol

1½

THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

END