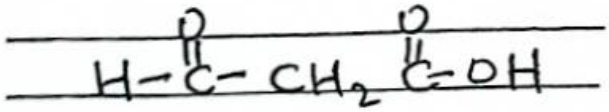
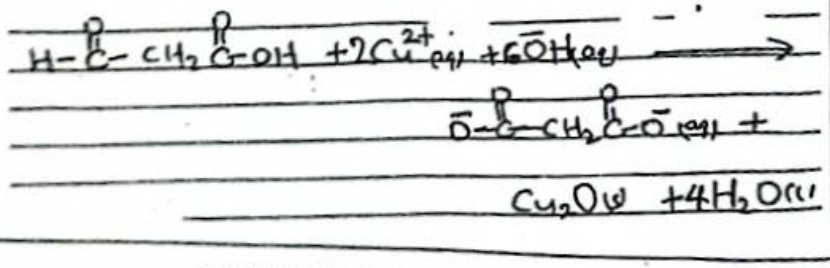
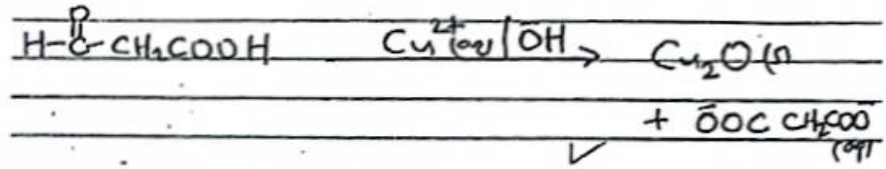
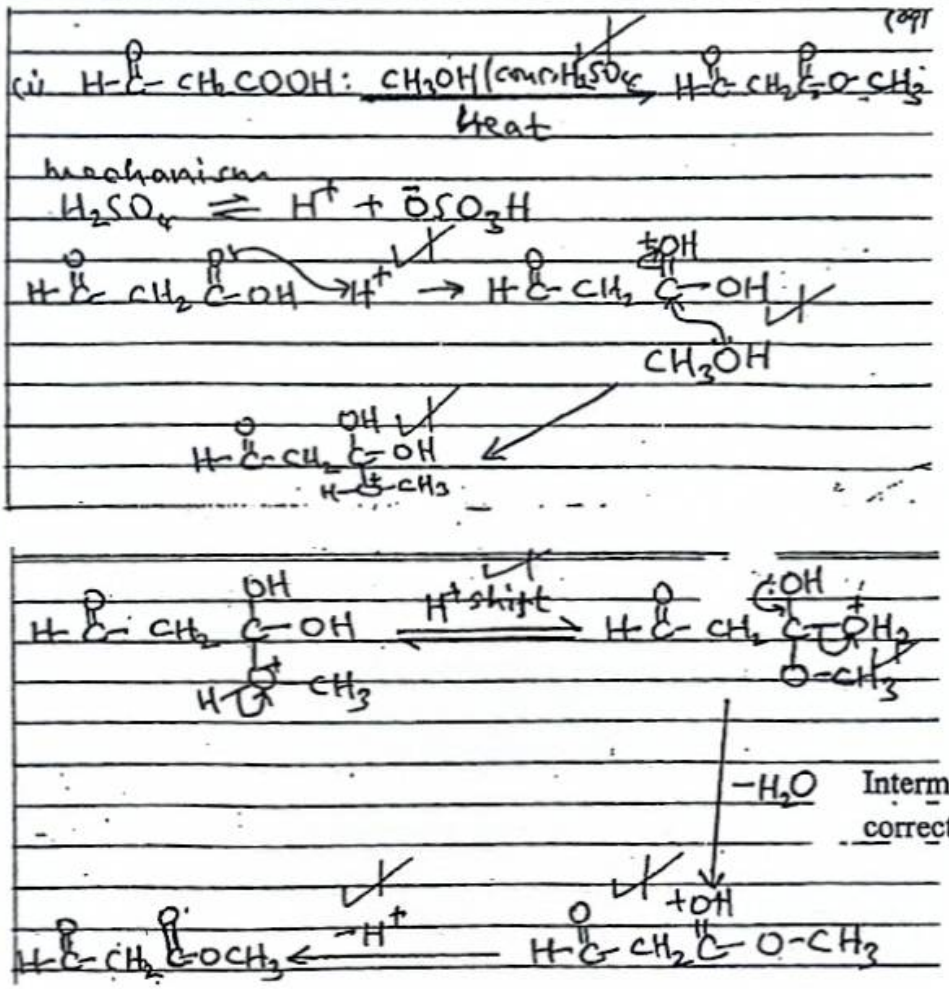
WAKISSHA JOINT MOCK EXAMINATIONS
SCORING GUIDE
Uganda Certificate of Education
Chemistry P525/2
July/August 2025

1. (a) (i)	Mass of carbon = $\frac{12}{44}$ x 3.3 = 0.9g Mass of hydrogen = $\frac{2}{18}$ x 0.9 = 0.1g Mass of oxygen = 2.2 – (0.9 + 0.1) = 1.2 C H O Masses 0.9 0.1 1.2 Moles $\frac{0.9}{12}$ $\frac{0.1}{1}$ $\frac{1.2}{16}$ 0.075 0.1 0.075 Mole ratio $\frac{0.075}{0.075}$ $\frac{0.1}{0.075}$ $\frac{0.075}{0.075}$ (1: 1.333 : 1) x 3 3 : 4 : 3 Empirical formula of W is $C_3H_4O_3$	3½
(ii)	Rmm = v.d x 2 = 44 x 2 = 88 - ½ for units given for Rmm $(C_3H_4O_3)n = 88$ $(12 \times 3 + 1 \times 4 + 16 \times 3)n = 88$ $= 88n = 88$ $n = 1$ molecular formula of W is $C_3H_4O_3$	02
(b)		½
(c)	3-oxopropanoic acid Red precipitate (Reddish brown precipitate 	1½

OR 

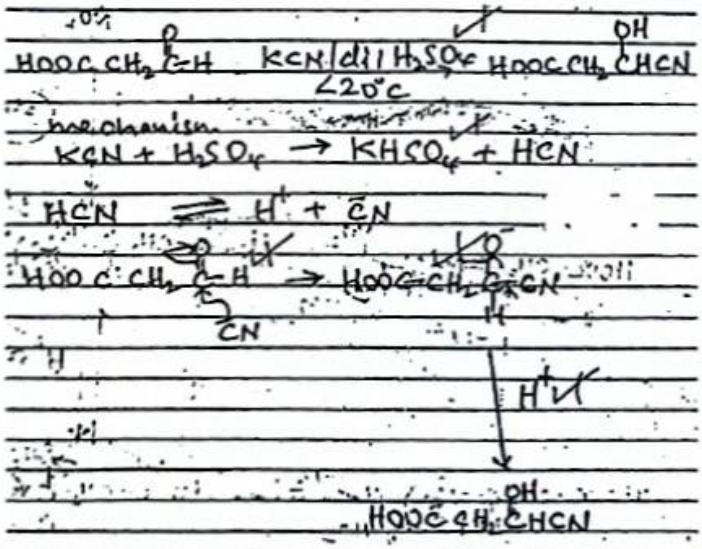
(d) (i)



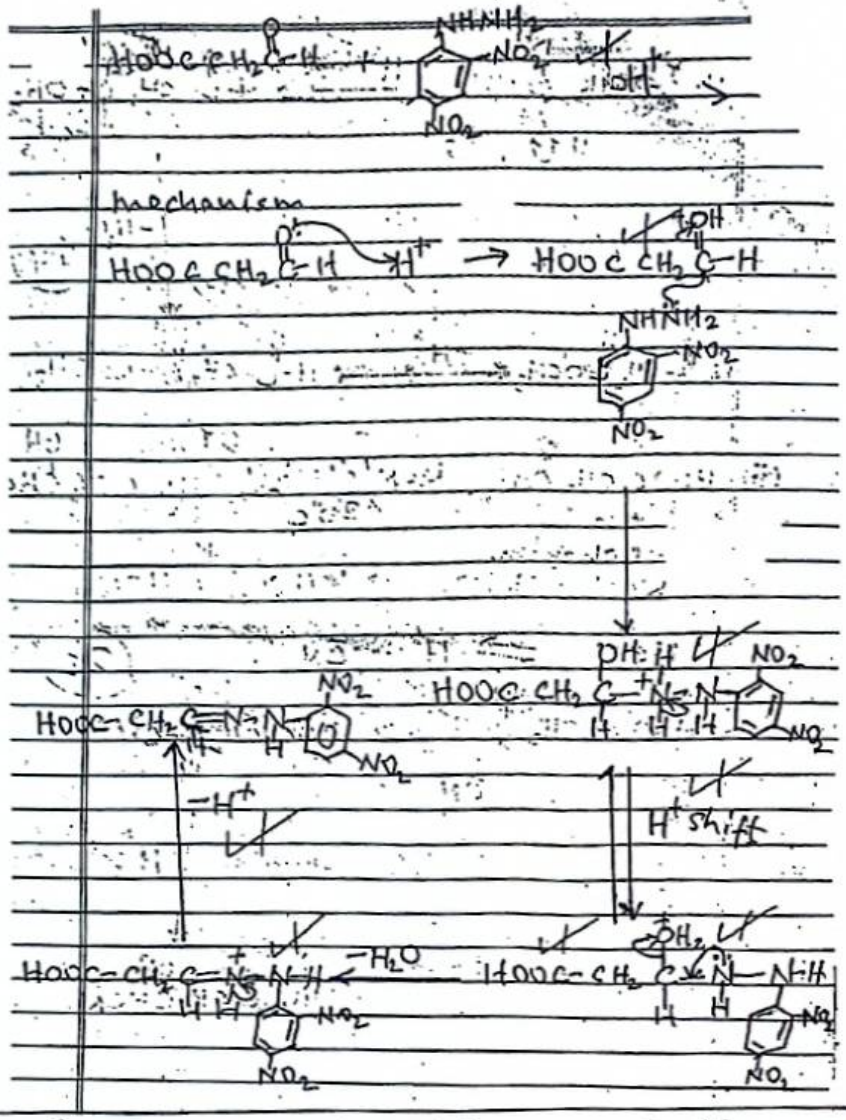
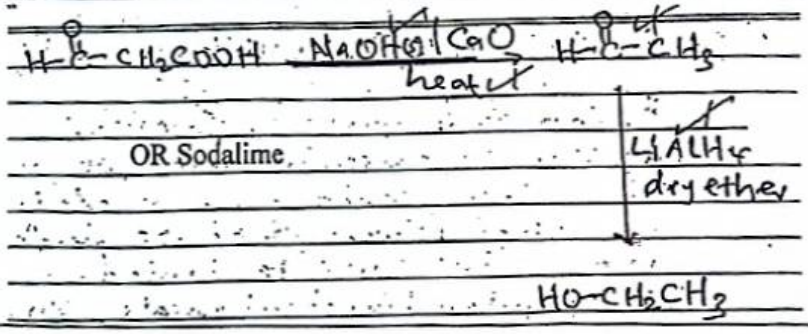
Intermediate must correct

04

(ii)



2 ½

(iii)		04 marks
(e)		02 marks
		20 marks
2.(a) (i)	Rate law is an expression, or equation that provides a relationship between the rate of the reaction and the concentrations of the reactants raised to appropriate powers which are experimentally determined. Stoichiometric equation is one in which the number of atoms in one side is equal to the number of atoms in the other side of the equation. Or is a balanced equation.	01 mark 01 mark
(ii)	The rate will increase by 16 times. Reject the rate is increased by 16(sixteen) Accept the rate in multiplied by 16.	02 marks

(iii) $K = \dfrac{\text{Rate}}{[BrO_3^-][H^+]^2[Br^-]}$

$= \dfrac{1.5\times10^{-5}}{(0.015)(0.02)^2(0.025)}$

$= 100 mol^{-3}dm^9s^{-1}$ ½ for units missing

2½

(b) (i) Rate = = K $[CH_3CO\,CH_3]$ deny if units wrong. 01 mark

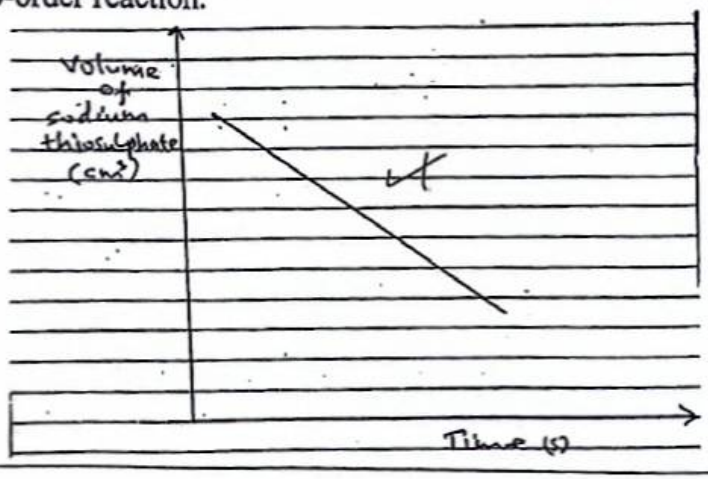
(ii) Known volume of propane, Iodine of known concentrations are mixed in a flask / container. On addition of a fixed volume of dilute Sulphuric acid, a stop clock is started.

At regular time intervals, known volumes of the reaction mixture are pipetted into different conical flasks containing excess sodium hydrogen carbonate solution. The acid is neutralized and the reaction stops.

The amount of Iodine remaining in the reaction mixture is determined by titrating the neutralized mixtures with a standard solution of sodium thiosulphate using starch indicator.

The volume of sodium thiosulphate required to reach the end point is directly proportional to the amount of Iodine remaining in the reaction mixture.

A graph of volume of sodium thiosulphate against time is plotted and a straight line graph with negative slope is obtained an indication that it is a zero-order reaction.



06

(c) (i)

Temperature T, K	555	606	645	714	769
$\frac{1}{T}$	0.0018	0.00165	0.00155	0.0014	0.0013
Rate constant, k	3.72×10^{-5}	3.72×10^{-4}	5.44×10^{-3}	0.111	0.819
Log_{10} k	-4.43	-3.43	-2.27	-0.955	-0.087

$2\frac{1}{2}$ 01

Slope $= \dfrac{-4.5 - {}^{-}0.087}{0.00181 - 0.0013}$

$= {}^{-}8652.941$

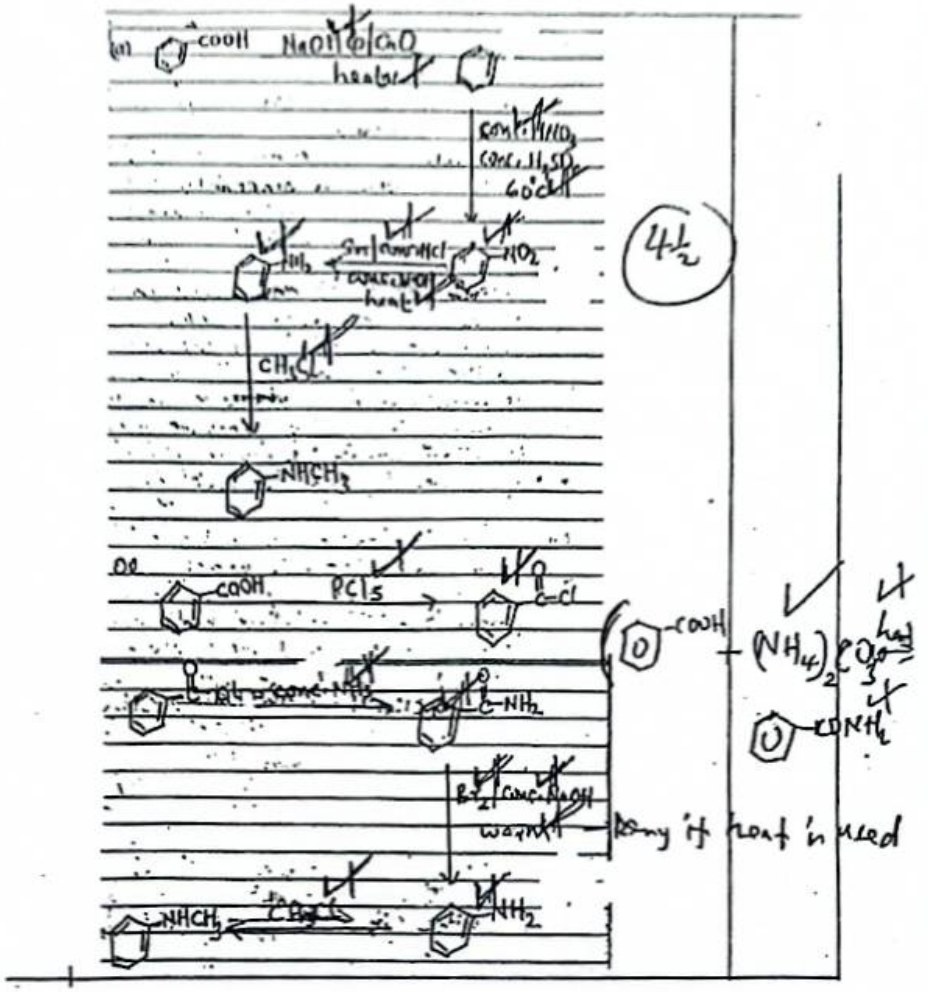
accept 2 dps for $log_{10}K$ accept at least 4 dps for $\frac{1}{T}$

	± 50 -8702 – 8602 From $K = Ae^{\frac{-Ea}{RT}}$ $\log_{10} K = \log_{10} A + \frac{-Ea}{RT}\log_{10}^{e}$ $\log_{10} K = \log_{10} A + \frac{-Ea}{2.303R} \times \frac{1}{T}$ $\therefore Slope = \frac{-Ea}{2.303R}$ $-Ea$ $-8652.91 = 2.303 \times 8.314$ $\therefore Ea = 165.679\ KJmol^{-1}$ (see graph at the back) Accept $Jmol^{-1}$	$\frac{1}{2}$ for aa units : Deny for wrong units.
		20 ma
3. (a)	For germin $4S^2\ 4P^2$ For lead $6S^2\ 6P^2$	01 ma
(b) (i)	Carbon does not react with sodium hydroxide under any condition. Silicon and tin react with hot concentrated sodium hydroxide to form silicate (IV) and stannate (IV) respectively together with hydrogen gas. $Si_{(s)} + 2\bar{O}H_{(aq)} + H_2O_{(l)} \rightarrow SiO_3^{2-}{}_{(aq)} + 2H_{2(g)}$ $Sn_{(s)} + 2\bar{O}H_{(aq)} + H_2O_{(l)} \rightarrow SnO_3^{2-}{}_{(aq)} + 2H_{2(g)}$ **OR** $Si_{(s)} + 2\bar{O}H_{(aq)} + 4H_2O_{(l)} \rightarrow Si(OH)_6^{2-}{}_{(aq)} + 2H_{2(g)}$ $Sn_{(s)} + 2\bar{O}H_{(aq)} + 4H_2O_{(l)} \rightarrow Sn(OH)_6^{2-}{}_{(aq)} + 2H_{2(g)}$	04 ½ $\frac{1}{2}$ for states wrong or missing Deny for only silicate or stannate.
(ii)	Carbon reacts with hot concentrated nitric acid to form carbon dioxide, nitrogen dioxide and (water:) $C_{(s)} + 4HNO_{3(aq)} \rightarrow CO_{2(g)} + 4NO_{2(g)} + 2H_2O_{(l)}$ Silicon does not react with nitric acid under any condition. Tin reacts with hot concentrated nitric acid to form tin (IV) oxide, nitrogen dioxide and (water.) $Sn_{(s)} + 4HNO_{3(aq)} \rightarrow SnO_{2(s)} + 4NO_{2(g)} + 2H_2O_{(l)}$	03
(iii)	Carbon reacts with hot concentrated sulphuric acid to form carbon dioxide, sulphur dioxide and (water). $C_{(s)} + 2H_2SO_{4(l)} \rightarrow CO_{2(g)} + 2SO_{2(g)} + 2H_2O_{(l)}$ Tin reacts with hot concentrated Sulphuric acid to form tin (IV)	03

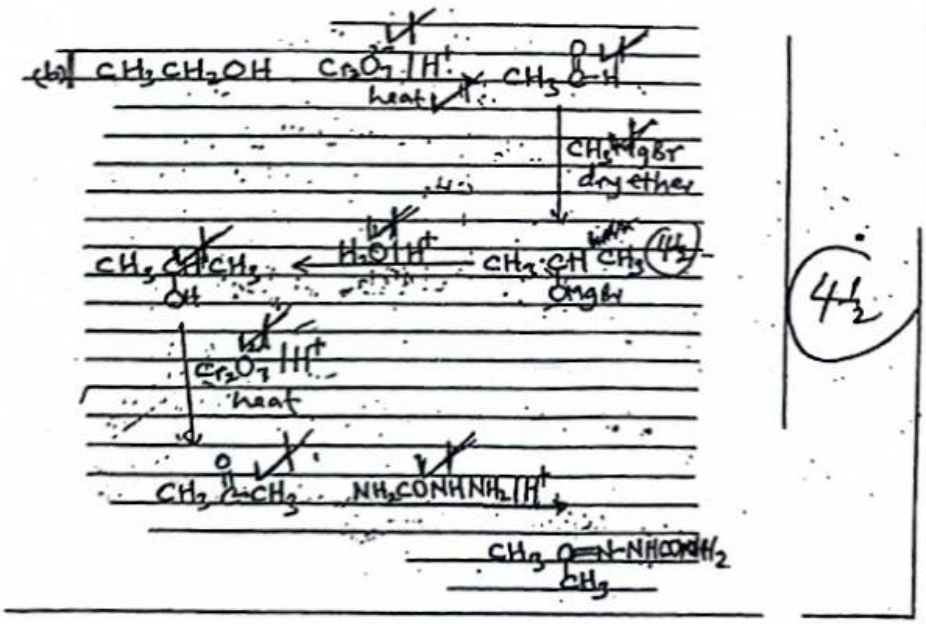
	Sulphate, Sulphur dioxide and (water). $Sn_{(s)} + 4H_2SO_{4(l)} \rightarrow Sn(SO_4)_{2(aq)} + 2SO_{2(g)} + +4H_2O_{(l)}$ $\frac{1}{2}$ for states wrong or missing Silicon does not react with Sulphuric acid under any condition.	
(c) (i)	Pb O % 90.66 9.34 Moles $\frac{90.66}{207}$ $\frac{9.34}{16}$ 0.43797 0.58375 Mole ratio $\frac{0.43797}{0.43797}$ $\frac{0.58375}{0.43797}$ (1 : 1.333) x 3 3 : 4 Simplest formula of Q is Pb_3O_4	03
ii)	Q reacts with hot concentrated Sulphuric acid to form lead (II) Sulphate oxygen gas and water. $Pb_3O_{4(s)} + 3H_2SO_{4(l)} \rightarrow 3PbSO_{4(s)} + \frac{1}{2}O_{2(g)} + 3H_2O_{(l)}$ Q reacts with hol concentrated sodium hydroxide solution to form plumhate (II) and plumbate (IV) $Pb_3O_{4(s)} + 6\bar{O}H_{(aq)} \rightarrow 2PbO_2^{-2}{}_{(aq)} + PbO_3^{2-}{}_{(aq)} + 3H_2O$ OR $Pb_3O_{4(s)} + 6\bar{O}H_{(aq)} + 4H_2O_{(aq)} \rightarrow 2Pb(OH)_4^{2-}{}_{(aq)} + Pb(OH)_6^{2-}{}_{(aq)}$	For both $5\frac{1}{2}$
		20 marks
4.(a) i)	Vapour pressure is the pressure exerted by the vapour which is in (dynamic) equilibrium with its liquid. Osmotic pressure is the pressure exerted on the solution to balance or prevent the movement of solvent molecules from a region of low solute concentration to a region of high solute concentration through a semi – permeable membrane.	02 marks
ii)	Vapour pressure decreases with increase in the concentration of a solution because the surface of the solution is occupied by many solute particles which prevent escape of solvent molecules into vapour phase and thus vapour pressure reduces. Osmotic pressure increases with increase in concentration of the solution because increase in concentration increases the concentration gradient and thus the rate of diffusion of solvent molecules into the solution increases and thus osmotic pressure will also increase.	03
b) (i)	***Graph at the back***	

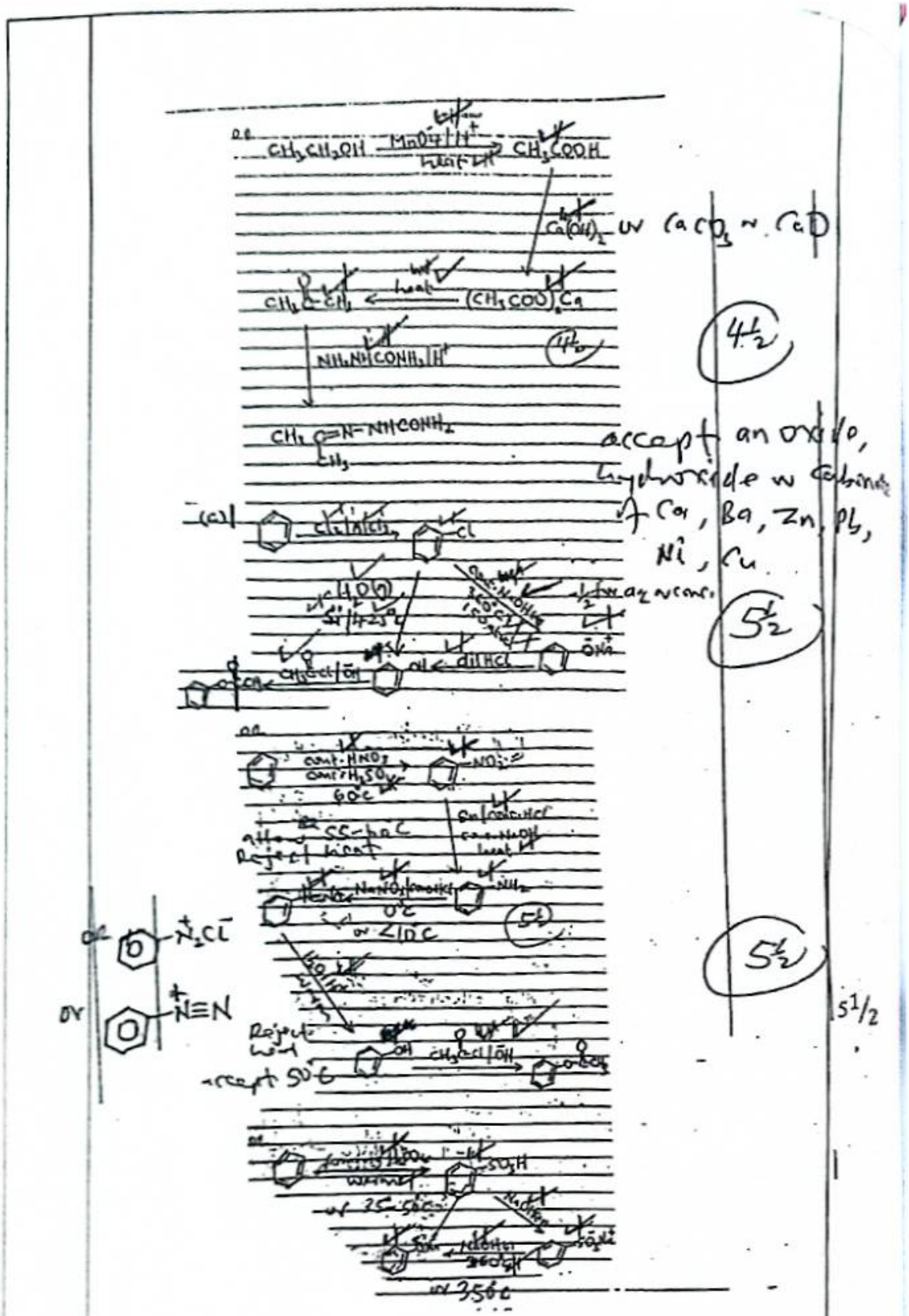
(ii)	Slope $= \frac{7.5-0.7}{123-12}$ $= \frac{6.8}{111}$ $= 0.06126 \pm 0.005$ (0.05626 to 0.06626) $slope \times 10^{-3} = \frac{RT}{Mr}$ $Mr = \frac{8.314 \times 298}{0.0616 \times 10^{-3}} = 40,443,552.073$	
	$(C_6H_{10}O_5)n = 40,443,552.073$ $(12 \times 6 + 1 \times 10 + 16 \times 5)n = 40,443,552.073$ $162n = 40,443,552.073$ $n = 249,652$ Deny if dps are used.	3 ½
(c)	A known mass of a solute is dissolved in a known volume of the solvent to form a solution of known concentration at a given temperature. A pure solvent is placed in the inner tube until it reaches mark x in the capillary tube. A solution is placed in the outer casing which is connected to the piston and pressure gauge. A pressure is applied on the solution so that the level of the solvent is maintained at mark x in the capillary tube. The pressure applied is called osmotic pressure and is measured by the pressure gauge.	05 marks
(d)	Soluble starch has a very high relative molecular mass and since freezing point depression is inversely proportional to relative molecular mass, the freezing point depression would be too small to be measured by normal ordinary thermometers. With osmotic pressure, any change in concentration would result into osmosis taking place and thus osmotic pressure would develop.	03 marks

5. (ii)

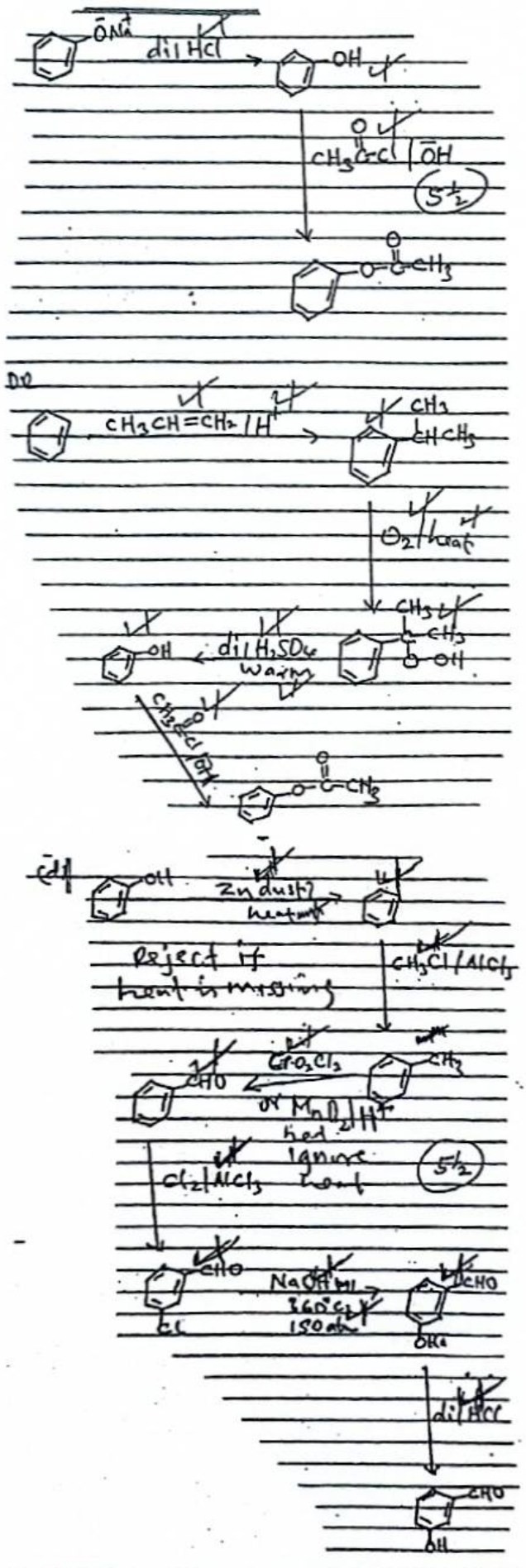

COOH
NaOH/CaO
heat
Conc. HNO3
Conc. H2SO4
60°C
NO2
Sn/conc.HCl
conc.NaOH
heat
CH3Cl
NHCH3
PCl5
COOH
C=O
Cl
NH2
Br2/conc.NaOH
warm
NHCH3
NH2
(NH4)2CO3
heat
CONH2
4½

b)


CH3CH2OH
Cr2O7/H+
heat
CH3COOH
CH3MgBr
dry ether
CH3CH(OH)CH3
H2O/H+
CH3CH=CH2
Anhy
Cr2O7/H+
heat
CH3COCH3
NH2CONHNH2/H+
CH3C(CH3)=N-NHCONH2
4½


4½
accept any oxide, hydroxide w cations of Ca, Ba, Zn, Pb, Ni, Cu.
5½
5½
5½

(d)

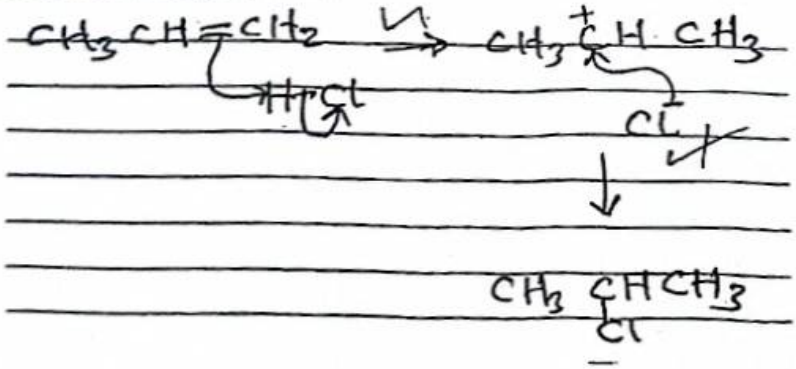


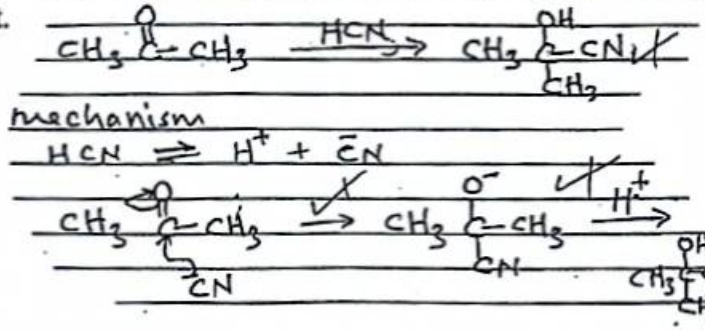
Reject is OH in missing

$5\frac{1}{2}$

	the molar conductivity of lead (II) bromide at infinite dilution $\Lambda\infty\ PbBr_2 = \Lambda\infty Pb^{2+} + 2\Lambda\infty Br^-$ The solubility product determined as follows; $\Lambda c = \frac{K}{C}$ Solubility of lead (II) bromide is very small. But $\Lambda c \simeq \Lambda\infty$ since the solubility of lead (II) bromide is very small. $C = \frac{K}{\Lambda\infty}$ $Pb\ Br_{2(s)} + aq \leftrightharpoons Pb^{2+}_{(aq)} + 2Br^-_{(aq)}$ c c 2c $Ksp = [Pb^{2+}]\ [Br^-]^2$ $= c\ (2c)^2$ $= 4c^3\ mol^3\ dm^{-9}$ deny without correct units	06 marks
(c) (i)	RFM of $PbBr_2 = 207 + 80 \times 2$ $= 367$ $[PbBr_2] = \frac{7.84}{367}$ $= 0.02136\ moldm^{-3}$	
6(a) (i)	Solubility product is the product of the molar concentration of the ions of a sparingly soluble electrolyte (salt) raised to appropriate powers in a saturated solution at a given temperature. Reject compound or substance	01
(ii)	Common ion effect is the precipitation of a sparingly soluble salt from its saturated solution on addition of a more soluble compound with one ion common to both at a given temperature.	01
(b)	Excess of solid lead (II) bromide is mixed with a known volume of distilled water in a flask. The flask is stoppered and the mixture shaken vigorously for some time until equilibrium is attained at room temperature. Deny $\frac{1}{2}$ for room temperature missing The mixture is filtered to obtain a filtrate which is a saturated solution of lead (ii) bromide. The electrolytic conductivity of the saturated solution is measured using a conductivity meter. The electrolytic conductivity of pure water is determined using the same meter. Ksolution = Ksolute + Kwater The molar conductivity of lead (II) ions and bromide ions at infinite dilution are obtained from the data book and are used to determine solubility of $PbBr_2 = 367 \times 0.006980$ $= 2.5618\ gdm^{-3}$ Mass of lead (II) bromide that precipitated $= 7.84 - 2.5618$ $= 5.2782\ g$	$3\ \frac{1}{2}$

(ii)	Let y be the solubility of $PbBr_2$ in 0.1M NaBr.	
	$PbBr_{2(s)} + aq \rightleftharpoons Pb^{2+}_{(aq)} + 2Br^-_{(aq)}$ y y 2y $NaBr_{(aq)} \rightarrow Na^+_{(aq)} + Br^-_{(aq)}$ 0.1M 0.1M 0.1M $[Pb^{2+}] = y$ $[Br^-] = 2y + 0.1$ $\simeq 0.1$ M since $y <<< 0.1$ $3.891 \times 10^{-5} = y(0.1)^2$ $y = \frac{3.8981 \times 10^{-5}}{0.01}$ $= 3.8981 \times 10^{-3}$ Mass of $PbBr_2$ that dissolved $= 3.8981 \times 10^{-5} \times 367$ $= 1.4306$g accept 2dp	$3\frac{1}{2}$ marks
(i)	$PbBr_{2(s)} + aq \rightleftharpoons Pb^{2+}_{(aq)} + 2Br^-_{(aq)}$ c c 2c $Ksp = [Pb^{2+}][Br^-]^2$ $= c(2c)^2$ $= 4c^3$ $= 4 \times (0.02136)^3$ $= 3.8981 \times 10^{-5}$ mol^3 dm$^-$ $PbBr_{2(s)} + aq \rightleftharpoons Pb^{2+}_{(aq)} + 2Br^-_{(aq)}$ x x 2x $Pb(NO_3)_{2(aq)} \rightarrow Pb^{2+}_{(aq)} + 2\ NO^-_{3(aq)}$ 0.2M 0.2M 0.4M $[Pb^{2+}] = x + 0.2$ $[Br^-] = 2x$ Since $x <<< 0.2$ $x + 0.2 \simeq 0.2$ $[Pb^{2+}] = 0.2$moldm^{-3} $Ksp = [Pb^{2+}][Br^-]^2$ $3.891\ x\ 10^{-5} = (0.2)(2x)^2$ $x = 0.00698$ % of $PbBr_2$ that dissolved $= \frac{1.4306}{5.0} \times 100$ $= 28.612\%$	$3\frac{1}{2}$ marks

(d) (i)	The solubility increases because nitric acid oxidises bromide ions to bromine. $2Br^-_{(aq)} + 4H^+_{(aq)} + 2NO^-_{3(aq)} \rightarrow Br_{2(g)} + 2NO_{2(g)} + 2H_2O_{(l)}$ The concentration of bromide ions in the solution reduces and more lead (II) bromide dissolves to restore the equilibrium such that the Ksp is maintained.	02 m
(ii)	The solubility increases because Magnesium ribbon reduces lead (II) ions to lead metal. $Pb^{2+}_{(aq)} + Mg_{(s)} \rightarrow Pb_{(s)} + Mg^{2+}_{(aq)}$ The concentration of lead (II) ions in the solution reduces and thus more lead (II) bromide dissolves to restore the lead (II) ion concentration such that the Ksp is maintained.	02 m
(e)	- Salting out of soap - Purification of common salt - Use of potassium chromate as an indicator. - Qualitative analysis.	01 m
		20 m
7(a)	Benzoic acid has a benzene ring which exerts a negative inductive effect due to delocalized pi electrons. The oxygen – hydrogen bond of the carboxyl group is weakened and thus can easily break and an aqueous solution of benzoic acid has a relatively high concentration of hydrogen ions. In ethanoic acid, the methyl group exerts a positive inductive effect and thus strengthens the oxygen – hydrogen bond of the carboxyl group and thus cannot easily break and the aqueous solution of ethanoic acid has a relatively low concentration of hydrogen ions.	04 m
(b)	Fluorine atom has only one isotope while chlorine atom has two isotopes of chlorine – 35 and chlorine – 37. Due to Isotopic combination, Chlorine molecule has three relative molecular masses and this gives rise to three peaks in the mass spectrum unlike fluorine which has one relative molecular mass and thus one peak.	03 m
(c)	Propene has a localized carbon to carbon double bond which is a centre of high electron density and thus is attacked by electron deficient species to form a single product. 	2½ 05 m

	In propanone, the carbonyl functional group is polar with oxygen being more electronegative than carbon and thus pulls bonding electrons towards itself, creating partial negative charge on oxygen. The partially positive carbon is attacked by electron rich species to from a single product.  	2½
(d)	Fluorine atom has a much smaller atomic radius than Chlorine atom. In fluorine molecule, the Ione pairs of electrons are closer to each other and thus exerts stronger repulsion and this weakens the fluorine bond and thus can easily break. In Chlorine molecule, the Ione pairs of electrons on the Chlorine atoms are far apart and thus exert less repulsion and the Chlorine – chlorine bond is relatively strong and thus cannot easily break.	03 marks
e)	Carbon dioxide partially Ionise in aqueous solution to form hydrogen ions which take part in the disproportionation of maganate (VI) ions to form Manganate (VII) ions and insoluble manganese (IV) oxide. $3MnO_{4\,(aq)}^{2-} + 2CO_{2(aq)} \rightarrow 2MnO_{4(aq)}^{-} + MnO_{2(aq)} + 2CO_{3\,(aq)}^{2-}$ OR $CO_{2(g)} + H_2O_{(l)} \rightleftharpoons H_{(aq)}^{+} + HCO_{3(aq)}^{-}$ $=3MNO_{4(aq)}^{2} + 4H_{(aq)}^{+} \rightarrow 2MnO_{4(aq)}^{-} + MnO_{2(s)} + 2H_2O_{(l)}$	04 marks
		20 marks
(a)	Ore is a naturally occurring mineral from which a metal is extracted. Or Is a naturally occurring rock from which a metal is extracted.	01mark 01 mark
»)	Copper Pyrites Reject pyrite or form ½	½ mark
:)	Copper Pyrites are crushed into powder and mixed with water containing a frothing agent such as pine oil. Air is blown into the mixture from agitation. The earthly impurities are welted and sink to the bottom. The ore particles are attracted to the frothing agent and floats on top and can be skimmed off. Dilute sulphuric acid is added to break the froth. The ore is filtered washed is roasted. The ore is roasted in a calculated amount of air to form copper (I) sulphide, sulphur dioxide and iron (II) oxide.	7½ marks

	$2CuFeS_{2(s)} + 4O_{2(g)} \rightarrow Cu_2S_{(s)} + 2FeO + 3SO_{2(g)}$ Silicon (IV) oxide is added and the mixture heated in the absence of a to form Iron (II) silicate in liquid state and can be poured off. The resulting product which is Copper (I) Sulphide is further roasted a limited amount of air to form Copper (I) oxide and Sulphur dioxide $2Cu_2S_{(s)} + 3O_{2(g)} \rightarrow 2Cu_2O_{(s)} + 2SO_{2(g)}$ The copper (i) oxide and un reacted copper(i) Sulphide are heated together in the absence of air to form impure copper and Sulphur dioxide. $2Cu_2O_{(s)} + Cu_2S_{(s)} \rightarrow 6Cu_{(s)} + SO_{2(g)}$ The impure copper is purified by electrolysis where the impure copper is made the anode and pure copper is made the cathode and the electrolyte is Copper (II) Sulphate solution. When current is passed through he electrolyte, impure copper anode dissolves to form copper (II) ions and copper (II) ions are discharged at the cathode and pure copper is deposited on the cathode. At the anode: $Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + 2e$ At the cathode: $Cu^{2+}_{(aq)} + 2e \rightarrow Cu_{(s)}$	
d(i)	Copper reacts with hot concentrated sulphuric acid to form copper (II) sulphate, sulphur dioxide and (water.) $Cu_{(s)} + 2H_2SO_{4(l)} \rightarrow CuSO_{4(aq)} + SO_{2(g)} + 2H_2O_{(l)}$ $= 1/2$ for states wrong or missing	03 marks
(ii)	Copper reacts with moderately concentrated nitric acid to form copper (II) nitrate, nitrogen monoxide and water. $3Cu_{(s)} + 8HNO_{3(aq)} \rightarrow 3Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4H_2O_{(l)}$ Copper reacts with hot concentrated nitric acid to form copper (II) nitrate, nitrogen dioxide and water. $Cu_{(s)} + 4HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2NO_{2(g)} + 2H_2O_{(l)}$	04 marks
(e)(i)	Dark brown precipitate formed $2Cu^{2+}_{(aq)} + Fe(CN)^{4-}_{6(aq)} \rightarrow Cu_2Fe(CN)_{6(s)}$	02 marks
(ii)	White precipitate in a brown solution. $2Cu^{2+}_{(aq)} + 4I^-_{(aq)} \rightarrow Cu_2I_{2(s)} + I_{2(aq)}$ = ½ for states wrong or missing	02 marks
		20 marks

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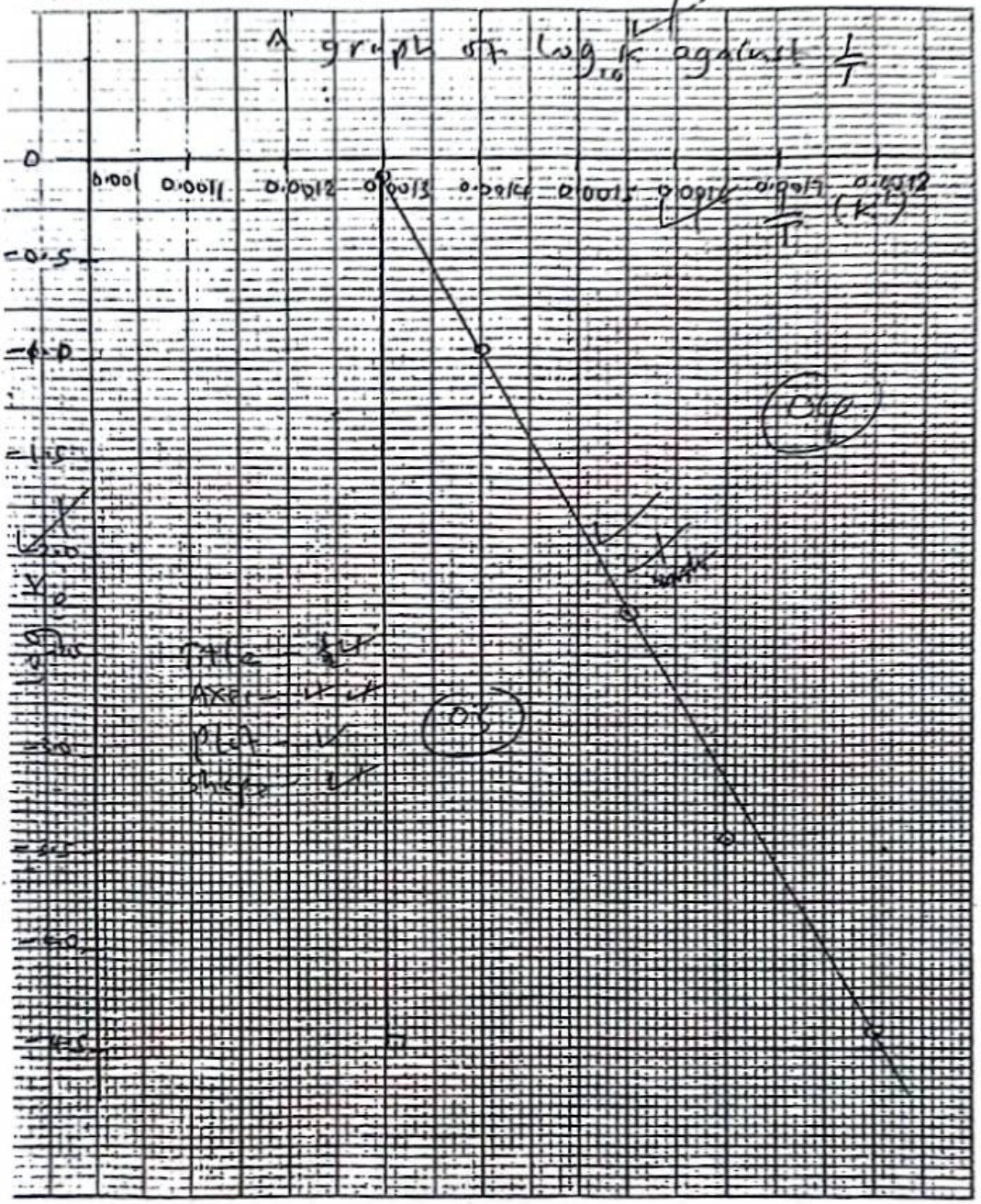
Paper code 1



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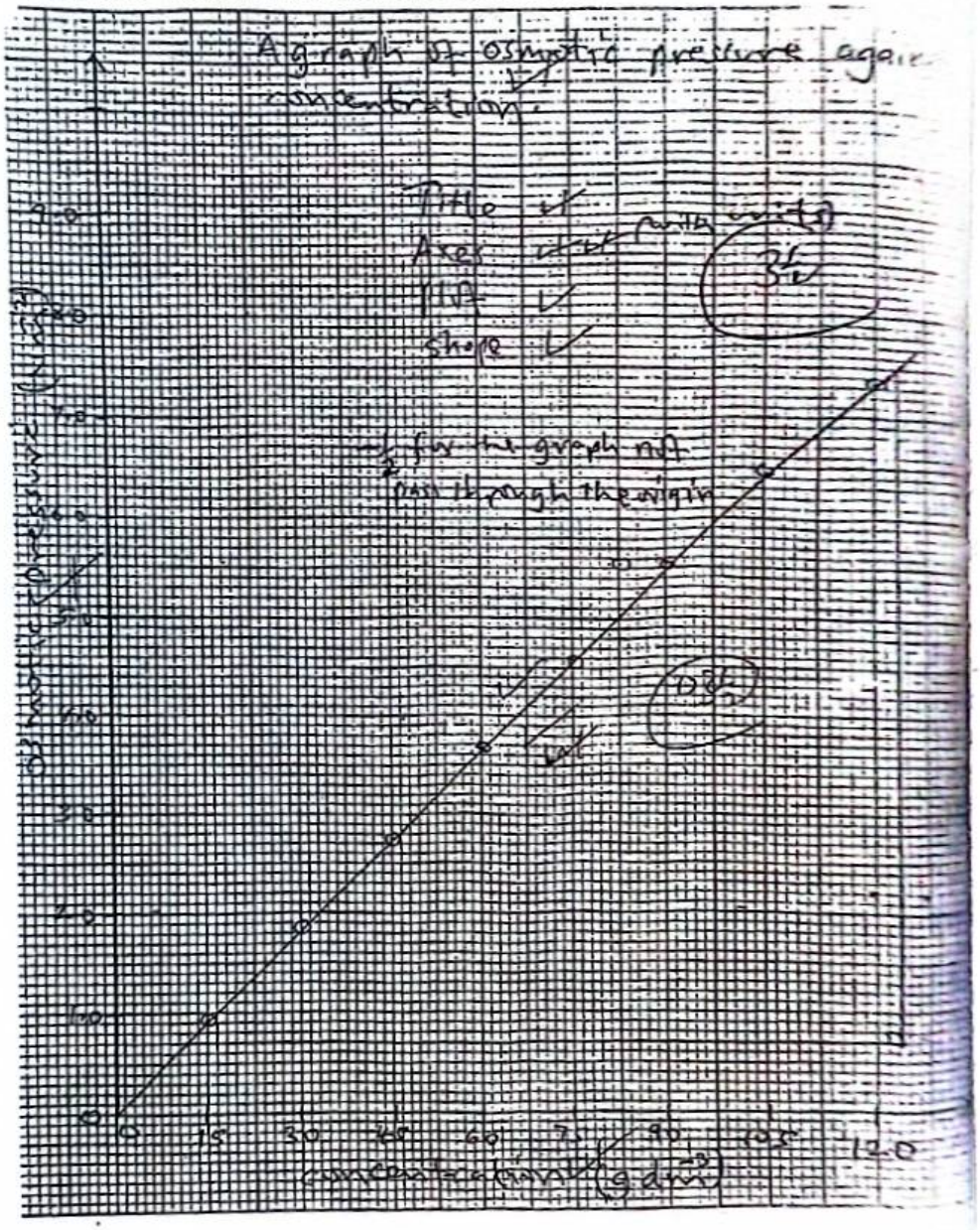

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