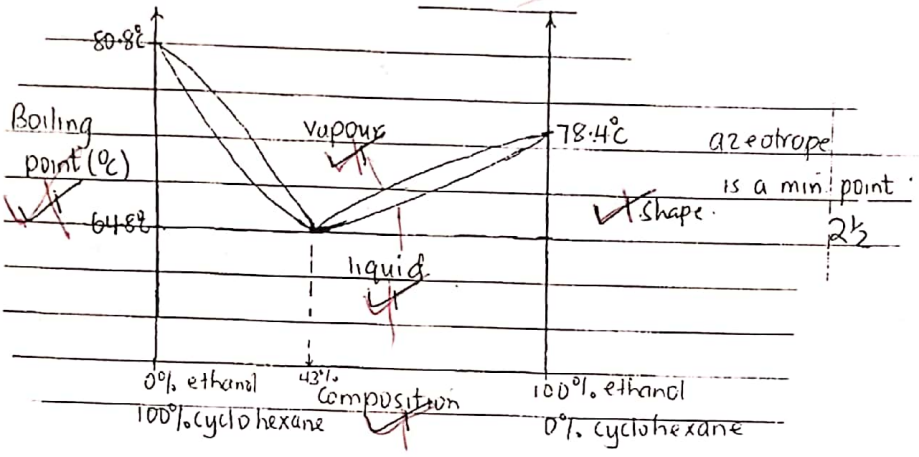
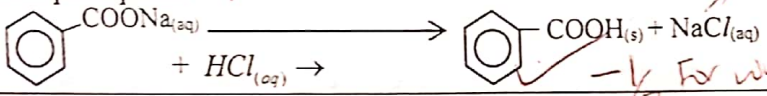
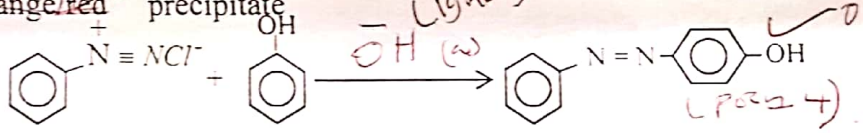
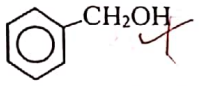
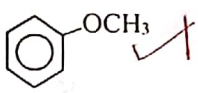
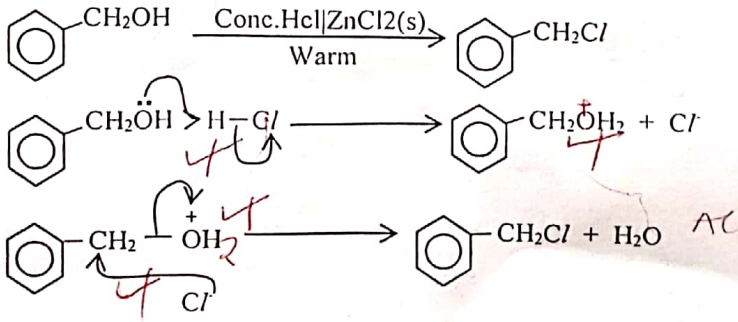
16.(a)(i)	Chlorine - 35	01
(ii)	R.A.M = $\frac{\sum \text{Isotopic mass X abundance}}{100}$ $= \frac{35X80 + 37X20}{100}$ =35.4	02
(b)	Chlorine has two Isotopes ; Chlorine – 35 and Chlorine – 37. The diatomic gaseous molecule is formed by different isotopic combination to give molecular ions of mass 70,72 and 74 $^{35}Cl + ^{35}Cl \rightarrow ^{70}Cl_2^+$ $^{35}Cl + ^{37}Cl \rightarrow ^{72}Cl_2^+$ $^{35}Cl + ^{35}Cl \rightarrow ^{70}Cl_2^+$ Each molecular ion forms a peak in the mass spectrum	04
(c)	It is accurate A small amount of sample is used.	02
		09 marks
17(a) (i)	**Graph paper.** Freezing point of pure water = 0.00° C. (Intercept from graph)	01 mark
(ii)	Slope = $\Delta T / \Delta M$ $= \frac{-0.05 + 0.80}{2.50 - 37.50}$ $= -0.0214286^0 Cg^{-1}$ Slope $= \frac{-100Kf}{\text{mass of solvent x Mx}}$ $-0.0214286 = \frac{-100 \times 1.86}{250 \times Mx}$ Mx = 347.20g/mol.	2½
(b)(i)	Ionic compounds dissociate in water into ions. The number of non- violatile solute particles in solution increase thus increasing the freezing point depression. Since molar mass is inversely proportional freezing point depression, the observed value of molar mass is less than expected.	1½
(ii)	Hexane is a non polar solvent in which short chain carboxylic acids dimerise/associate through hydrogen bonding. This halves/ reduces the number of non- volatile solute particles doubling/ increase the observed value of molar mass	1½

END

(ii)	**Positive deviation.** Addition of cyclohexane to ethanol weakens the hydrogen bonds between ethanol molecules. The escaping tendency of the molecules in solution increases thus the vapour pressure above the solution is greater than that expected for ideal solutions. At lower temperatures, the vapour pressure above solution is equal to the atmospheric pressure.	2½
(b)(i)		2½
(ii)	Distillate – azeotropic mixture (liquid mixture 43%.ethanol) Residue – pure ethanol.	02
(c)	Solvent extraction Distillation with a third component	01 **09 marks**
15.(a)(i)	$BaCO_3$ - green precipitate insoluble in excess alkali. $BaCO_3$ - White precipitate insoluble in excess alkali.	02
(ii)	Silver nitrate solution followed by dilute nitric acid KI – Yellow precipitate soluble in nitric acid. NaBr – Cream/pale yellow precipitate sparingly soluble in nitric acid.	02
(b)(i)	Iodide ions reduce copper (ii) ions to sparingly soluble copper (i) Iodide and themselves oxidized to Iodine. $2Cu^{+}_{(aq)} + 4I^{-}_{(aq)} \rightarrow Cu_2I_{2(s)} + I_{2(aq)}$	02½
(ii)	Hydrogen sulphide partially ionizes in water or eqn. $H_2S_{(g)} + aq \rightleftharpoons 2H^{+}_{(aq)} + S^{2-}_{(aq)}$ In acidic medium, the high concentration of hydrogen ions suppresses the ionization of hydrogensulphide. Reducing the concentration of sulphide ions. The ionic product of sulphide ions and Nickel(ii) ions does not exceed the solubility product of Nickel(ii) Sulphide hence no precipitation.	02½ **09 marks**

7. (a)	Acid strength increases with increase in oxidation state of chlorine ($HOCl < HClO_3 < HClO_4$).	01
(b)	Oxygen is more electronegative than chlorine hence has a negative inductive effect whose magnitude increase with number of oxygen atoms per acid molecule. The oxygen-hydrogen bond in each oxo acid becomes much weaker as oxidation state increases from chloric(i) to chloric (vii) acid and thus breaks more readily to release higher concentrations of hydrogen ions into solution.	03
(c) (i)	(Pale) green solution turns brown.	½
(ii)	$ClO^-_{4(aq)} + 8H^+_{(aq)} + 8Fe^{2+}_{(aq)} \rightarrow Cl^-_{(aq)} + 8Fe^{3+}_{(aq)} + 4H_2O_{(l)}$	1½
		06 marks
8.(a)	Observation Yellow oily liquid (yellow oil) $(CH_3CH_2)_2NH \xrightarrow[O^oC]{NaNO_{2(aq)}\,/\,Conc.HCl} (CH_3CH_2)_2N-N=O$	1½
(b)	Observation White precipitate  	1½
(c)	Observation: Orange/red precipitate  	02
		05 marks
9.(a)(i)	$SnCl_2, SnCl_4, CCl_4$.	1½
(ii)	$SnCl_{2(s)} + 2H_2O_{(l)} \rightleftharpoons Sn(OH)Cl_{(s)} + HCl_{(aq)}$ or (g) $SnCl_{4(l)} + H_2O_{(l)} \longrightarrow SnO_{2(s)} + 4HCl_{(aq)}$	01 01 01
(b)(i)	The orange solution turns green	½
(ii)	$3Sn^{2+}(aq) + Cr2O^{2-}_{7(aq)} + 14H^+_{(aq)} \longrightarrow 3Sn^{4+}_{(aq)} + 2Cr^{3+}_{(aq)} + 7H_2O_{(l)}$	01½
		05½
	SECTION B (54 MARKS)	
10(a)	The ratio of distance between two parallel (identical) electrodes to their cross-selection area. OR Cell constant = l/A where; l =distance between parallel electrodes. A= cross-sectional area of identical electrodes.	01
(b)(i)	Cell constant = l/A $= 0.12/1.25664 \times 10^{-3}$ $= 95.493\ m^{-1}$	01
(ii)	Electrolytic conductivity, $K^1 = \frac{1}{R} \times l/A$	

	$= \frac{1}{93.92} \times 95.493 = 1.01675\Omega^{-1}m^{-1}$ $\text{Molar conductivity} = \frac{K^1}{C} = \frac{1.01675}{0.05 \times 1000}$ $0.02033\Omega^{-1}m^{-2}mol^{-1}$. (with units)	03
(c) (i)	Barium chloride has higher conductivity than Magnesium chloride.	01
(ii)	The barium ion (Ba^{2+}) has a larger ionic radius hence a lower charge density than magnesium ion (Mg^{2+}). In solution, the Ba^{2+} ions is less hydrated thus has higher ionic mobility than the more hydrated Mg^{2+} ion.	03
		09 marks
11.(a)(i)	**C : H : O** $\frac{77.78}{12} : \frac{7.41}{1} : \frac{14.81}{16}$ $\frac{6.481}{0.926} : \frac{7.410}{0.926} : \frac{0.926}{0.926}$ 7 : 8 : 1 C_7H_8O	02
(ii)	$\frac{P_2^Q O}{P^Q Q} = \frac{\text{Number of moles of water in distilled}}{\text{Number of moles of Q in distilled}}$ $\frac{639}{760-639} = \frac{(100-53.18)/18}{53.18/MQ}$ MQ = 108 (12 x 7 + 8 x 1 + 16)n = 108. n = 1 Q - ~~GH_8O~~ C_7H_8O	03
(b)(i)	 Phenylmethanol.	01
(ii)		½
(c) (i)	cloudy solution	½
(ii)		02
		09 marks

12.(a)

Na	Al	P
NaCl	$AlCl_3$	PCl_3 or PCl_5.
Ionic	Covalent	Covalent

03

(b) $NaCl > AlCl_3 > PCl_5 > PCl_3$

NaCl has a giant ionic structure with strong electrostatic forces between sodium ions and Chloride ions which require a lot of heat energy to break.

$AlCl_3$ is predominantly covalent due to high charge density of Aluminum ions which polarize the large Chloride ions thus reducing charge separation. Its molecules are held by weak intermolecular forces. PCl_3 and PCl_5 molecules are discrete and held by Van der waals forces whose magnitude increase with molecular mass.

2 ½

03

(c) NaCl – dissociates in water into its free ions.

$NaCl_{(aq)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$

$AlCl_3, PCl_5$ and PCl_5 undergo hydrolysis to form Aluminium hydroxide, Phospherous acid and phosphoric acid respectively with evolution of hydrogen chloride gas

$AlCl_{3(s)} + 3H_2O_{(l)} \rightarrow Al(OH)_{3(s)} + 3HCl_{(g)}$

$PCl_{3(l)} + 3H_2O_{(l)} \rightarrow H_3PO_3 + 3HCl_{(g)}$ or one of the Chlorides of P

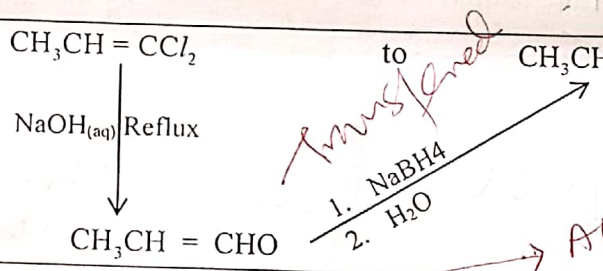
$PCl_{5(s)} + 4H_2O_{(l)} \rightarrow H_3PO_4 + 5HCl_{(g)}$

03

02½

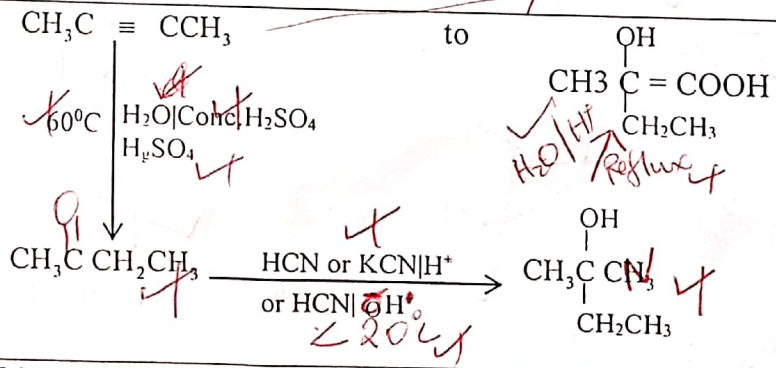
09 marks

13.(a)(i)



03

(ii)



½

03

(b). Ethanoic acid is reduced to ethanol by Lithium Aluminum tetrahydride in dry ether. Ethanol is mixed with excess concentrated sulphuric and heated to 180°C. it is dehydrated to ethane which is then reacted with bromine water to form 2 – bromoethanol.

03

09 marks

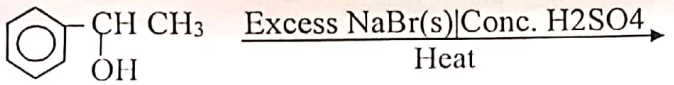
14 (a)(i) Azeotrope.

Uniform mixture of two or more miscible liquids which boils at constant temperature to form a vapour of the same composition at a given pressure.

01

4(a)(i)	Hydrogen bond or intermolecular hydrogen bonds	½
(ii)	R.F.M of HCOOH = 46 Observed R.F.M = 46X2 = 92	½
(b)	$\frac{\Delta P}{P0} = \frac{\text{moles of solute}}{\text{moles of solvent}}$ $\frac{\Delta P}{122} = \frac{0.092/92}{156/78}$ $\Delta P = \frac{0.001X122}{2} = 0.061\text{mmHg}.$ Vapour pressure of solution = 122 - 0.061 = 121.939mmHg.	2½
(c)	The vapour pressure of solution is lower than the vapour pressure pure benzene. The non-volatile methanoic acid particles occupy the surface of the solvent reducing the escaping tendency of volatile benzene molecules into vapour phase	1½
		05 marks
5.(a)(i)	$pH = -\log_{10}[H_3O^+]$ $[H_3O^+] = 10^{-6.24}$ $= 5.7544\times10^{-7}\ \text{moldm}^{-3}$	1½
(ii)	$Kh = \frac{[H_3O^+][NH_3]}{[NH_4^+]}$ $\frac{1.0\times10^{-14}}{1.78\times10^{-5}} = \frac{(5.7544\times10^{-7})^2}{[NH_4^+]}$ $[NH_4^+] = = 5.894134\times10^{-4}\text{M}.$ $(NH_4)_2SO_{4(aq)} \rightarrow 2NH^+_{4(aq)} + SO^{2-}_{4(aq)}$ Concentration of $(NH_4)_2SO_4 = \frac{1}{2}\times5.894134\times10^{-4}\times132$ $= 0.0389gdm^{-3}$	03
(b)(i)	The pH increases (slightly above 7).	½
(ii)	The mixture of ammonia and ammonium sulphate constitutes a basic buffer with a low concentration of hydroxide ions due to partial ionization of ammonia.	½ =01
		06 marks
6.(a)	Bond dissociation energy Heat energy absorbed to break/dissociate one mole of covalent bonds into free gaseous atoms.	01
(b)	$\Delta H_R = \sum B.E \text{ broken bonds} - \sum B.E \text{ bonds formed}$ $= [C=O + 2(N-H)] - [C=N + 2(O-H)]$ $= (1581 - 1541$ $= +40\text{KJmol}^{-1}$	03
		04 marks

WAKISSHA JOINT MOCK EXAMINATIONS
MARKING GUIDE
Uganda Advanced Certificate of Education
UACE August
CHEMISTRY P525/1

1. (a)	Measurement of colour intensity of the reaction mixture/Titration (of the reaction mixture with a standard solution of sodium thiosulphate/starch indicator)	01
(b) (i)	Rate of reaction increases Iron (ii) ions act as a catalyst by providing an alternative reaction path of lower activation energy.	1½
(ii)	Rate of reaction remains constant. Order of reaction with respect to each reactant is one.	1½
(iii)	Rate decreases/reduces. The kinetic energy of reactant ions is lowered, Frequency of effective collisions decreases and the value of the rate constant decreases	1½ **5 ½ marks**
2.(a)	$CH_3C(=O)NH_2 + NaOBr_{(aq)} \longrightarrow CH_3NH_2$ Name of product Methylamine (amino methane)	1½
(b)	 1-bromo-1-phenylethane. phenylethane.	1½ (both correct)
(c)	$(CH_3)_2C{=}CHCH_3 \xrightarrow[\text{Heat}]{\text{Conc.}KMnO_4/H_2SO_4} CH_3COCH_3 + CH_3COOH$ Names CH_3COCH_3 Propanone CH_3COOH- Ethanoic acid	02 **05marks**
3(a)(i)	MnO	½
(ii)	MnO_2	½
(iii)	Mn_2O_7	½
(b)(i)	$MnO_{(s)} + H_2SO_{4(aq)} \longrightarrow MnSO_4(aq) + H_2O_{(l)}$	01
(ii)	$MnO_2(s) + 4HCl(aq) \longrightarrow MnCl_2(aq) + Cl_2(g) + 2H_2O_{(l)}$	01
(iii)	$Mn_2O_7(l) + 2OH^-_{(aq)} \longrightarrow 2NaMnO_4^-(aq) + H_2O_{(l)}$ Or $Mn_2O_7(l) + 2NaOH(aq) \longrightarrow 2NaMnO_4(aq) + H_2O_{(l)}$	01 **05 marks**