WAKISSHA MOCK-2023
CHEM1 MARKING GUIDE

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SFrank

P525/1
CHEMISTRY
Paper 1
July/August 2023
2 ¾ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- *Attempt all questions in section A and any six questions from section B.*
- *All questions are to be answered in the spaces provided.*
- *A Periodic Table with relevant atomic masses is supplied at the end of the paper.*
- *Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.*
- *Illustrate your answers with equations where applicable.*
- *Molar gas volume at s.t.p = 22.4 dm^3*

For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

Turn Over

SECTION A (46 MARKS)

Attempt all questions in this section.

1. (a) Sodium -24 which is used as an electrolytic tracer decays by emission of a beta particle and two gamma rays with half-life of 15 hours. Write the nuclear reaction for the decay of sodium –24. (01 mark)

$^{24}_{11}Na \longrightarrow {}^{24}_{12}Mg + \beta + 2\gamma$ 01

(b) 2.4g of sodium -24 were allowed to disintegrate for 72 hours. Calculate the mass of the radioactive isotope that decayed. (04 marks)

From $t_{\frac{1}{2}} = \frac{0.693}{K}$ From $2.303 \log\left(\frac{N_o}{N_t}\right) = Kt$

$K = \frac{0.693}{15}$ $2.303 \log\left(\frac{2.4}{N_t}\right) = 0.0462 \times 72$

$K = 0.0462$ $\log\left(\frac{2.4}{N_t}\right) = \frac{0.0462 \times 72}{2.303}$ 04

$\frac{2.4}{N_t} = 10^{1.4443769}$ $N_t = 0.0863$

Amount decayed $= 2.4 - 0.0863$

(01 mark) $= 2.3137$ g

(c) State any two other uses of radioactive isotopes.

- Radioactive oxygen-18 is used in determination of mechanism of esterification reaction.
- Radioactive carbon-14 is used in carbon dating 01

2. The atomic number of chromium is 24.

(a) Write the;

(i) electronic configuration of chromium. (01 mark)

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ 01

(ii) formulae of three common oxides of chromium. (1½ marks)

Cr_2O_3, CrO_3, CrO 1½

(b) The oxide(s) in a(ii) are either basic, amphoteric or acidic. Write an equation for the reaction between the;

(i) basic oxide of chromium and dilute mineral acids. (1½ marks)

$CrO_{(s)} + 2H^+_{(aq)} \longrightarrow Cr^{2+}_{(aq)} + H_2O_{(l)}$ 1½

(ii) acidic oxide of chromium and sodium hydroxide solution. (1½ marks)

$CrO_{3(s)} + 2NaOH_{(aq)} \longrightarrow Na_2CrO_{4(aq)} + H_2O_{(l)}$ 1½

3. Complete the following equations and in each case outline a suitable mechanism for the reaction.

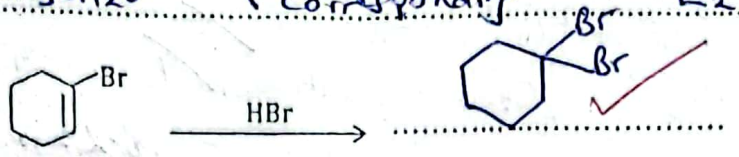
(a) $CH_3CH_2Br \xrightarrow[\text{Heat}]{CH_3CH_2\bar{O}Na^+/\text{alcohol}} CH_3CH_2OCH_2CH_3$ (03 marks)

Mechanism:

$CH_3CH_2\bar{O}Na^+ \longrightarrow CH_3CH_2\bar{O} + Na^+$ 03

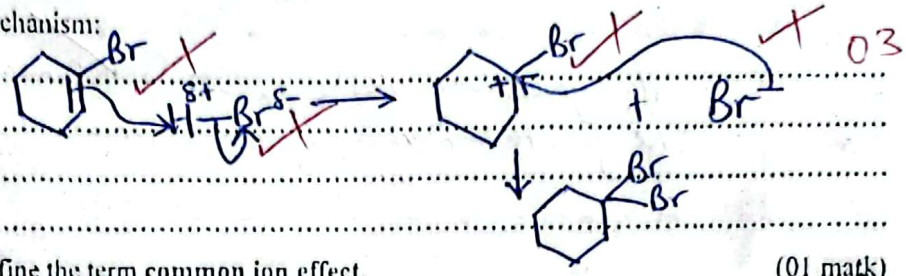
$CH_3CH_2Br \longrightarrow CH_3CH_2OCH_2CH_3$

$CH_3CH_2\bar{O}$ (Accept formation of ethene and mark corresponding E_2 mechanism).

(b) 

(03 marks)

Mechanism:



03

4. (a) : Define the term common ion effect. (01 mark)

Is the precipitation of a salt from its saturated solution by adding an aqueous solution of a soluble salt containing a common ion to the ions in the equilibrium of the sparingly soluble salt. 01

(b) The solubility of Lead (II) chloride in 0.02 M calcium chloride at 25°C is 2.951625 gdm^{-3}.

(i) Calculate the solubility of lead (II) chloride in gdm^{-3} in pure water at 25°C. (05 marks)

RFM of $PbCl_2$
$= 207 + 35.5 \times 2$
$= 278$

$[PbCl_2] = \frac{2.951625}{278}$
$= 0.106M$

From $PbCl_{2(s)} + aq \rightleftharpoons Pb^{2+}_{(aq)} + 2Cl^-_{(aq)}$

$K_{sp} = [Pb^{2+}][Cl^-]^2$

But $CaCl_{2(aq)} \longrightarrow Ca^{2+}_{(aq)} + 2Cl^-_{(aq)}$

$[Cl^-] = 2(0.02)$
$= 0.04M$

$K_{sp} = [Pb^{2+}][Cl^-]^2$
$= 0.106 \times (0.04)^2$
$K_{sp} = 1.696 \times 10^{-4} mol^3 dm^{-9}$ 05

Let the solubility in water be $x\ moldm^{-3}$.

$K_{sp} = x(2x)^2$
$K_{sp} = 4x^3$

$\sqrt[3]{\frac{1.696 \times 10^{-4}}{4}} = \sqrt[3]{x^3}$ (½ mark)

$x = 3.487 \times 10^{-2}$

RFM of $PbCl_2 = 278$

1 mole weighs 278g

3.487×10^{-2} moles weigh $278 \times 3.487 \times 10^{-2}$

$= 9.69386 gdm^{-3}$

(ii) Comment on your answer in b(i) above.

Lead (II) chloride has a higher solubility in water than in 0.02M Calcium chloride. 0½

5. The enthalpies of some chemical reactions are given below.

Reaction	ΔH^{θ} ($KJmol^{-1}$)
(i) $MgO_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H2O_{(l)}$	-146.2
(ii) $Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H2_{(g)}$	-478.4
(iii) $2H_{2(g)} + O2_{(g)} \longrightarrow 2H_2O_{(l)}$	-572

(03marks)

(a) Calculate the enthalpy of formation of magnesium oxide.

Required equation

$Mg_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow MgO_{(s)} \quad \Delta H = ?$

(ii) + $\frac{1}{2}$(iii) + reversed (i)

$\Rightarrow Mg_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow MgO_{(s)} \quad \Delta H = -478 + \frac{1}{2}(-572) + 146.2$

$\Delta H = -618.2\ KJmol^{-1}$

03

(b) State whether Magnesium oxide is stable or not. Give a reason for your answer.
(1½marks)

Magnesium oxide is stable since it has a negative enthalpy of formation. 1½

6. The physical properties of the hydrides of fluorine and Iodine are shown below.

Hydride	HF	HI
Boiling point	+19.9°C	-35.1°C
Physical state	Liquid	Gas

(a) Explain the variation in physical properties of the hydrides. (02marks)

Hydrogen fluoride is a liquid at room temperature because due to the high electronegativity of fluorine the molecules of hydrogen fluoride are held together by strong hydrogen bonds which can't be overcome at room temperature hence high boiling point and liquid state. In hydrogen Iodide, Iodine has very low electronegativity hence it's molecules are held together by weak vanderwaal forces which are easily overcome hence existing as a gas with very low boiling point.

02

(b) Describe the reactions of the hydrides with;

(i) sodium carbonate solution. (1½marks)

The hydrides react with Sodium carbonate solution to form salts, water and carbondioxide gas. For example,

$Na_2CO_{3(aq)} + 2HI_{(g)} \longrightarrow 2NaI_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

Hydrogen fluoride however forms a salt of Sodium hydrogen bifluoride ($NaHF_2$).

(ii) concentrated sulphuric acid. (1½ marks)

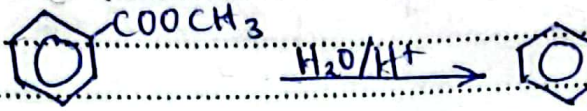
There is no reaction between hydrogen fluoride and concentrated sulphuric acid but concentrated sulphuric acid oxidises hydrogen iodide and itself reduced to sulphur dioxide

$H_2SO_{4(l)} + 2HI_{(g)} \rightarrow 2H_2O_{(l)} + SO_{2(g)} + I_{2(g)}$

(Accept reduction to H_2S, S, I_2 and H_2O).

7. Methylbenzoate was warmed with excess acidified water to form two organic products which were separated by distillation.

(a) Write an equation for the reaction that took place. (01 mark)



(b) Name a reagent that can be used to distinguish the products in (a) above. State what would be observed if each of the products is separately treated with the reagent you have named. (03 marks)

Reagent.

Sodium carbonate solution

Observation.

: Bubbles of a colourless gas that turns lime water milky

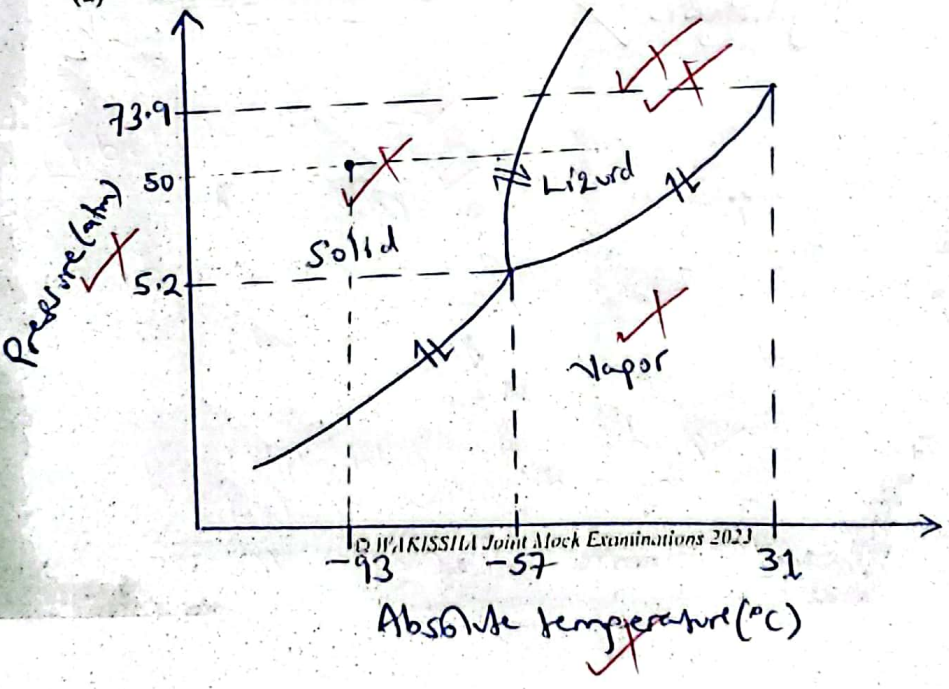
CH_3OH : No observable change

(c) State one other physical method by which the products of the reaction can be separated. (½ mark)

By filtration

8. Compound E expand normally and has a critical temperature of 31°C at 73.9 atm pressure. The triple point of E is −57°C at 5.2 atm pressure.

(a) Sketch a well-labelled phase diagram of E. (03 marks)



(b) State what would happen when E at;

(i) 180 K temperature and 50 atm pressure was heated at constant pressure. (01 mark)

when heated at constant pressure
it will melt to liquid state. 01

(ii) −57°C and 5.2 atm pressure was compressed at constant temperature. (01 mark)

when compressed at constant temperature
E will solidify 01

9. Lead (IV) oxide reacts with excess ice cold concentrated hydrochloric acid to form a complex liquid which forms a yellow precipitate on addition of a saturated solution of ammonium chloride. The dry precipitate reacts with concentrated sulphuric acid to form a pale yellow liquid.

(a) Name the;

(i) complex liquid. (½ mark)

hexachloroplumbic(IV) acid ½

(ii) yellow precipitate. (½ mark)

Ammonium hexachloroplumbate(IV) ½

(iii) pale yellow liquid. (½ mark)

Lead(IV) chloride ½

(b) Write an equation for the reaction between water and the pale yellow liquid. (01 mark)

$PbCl_{4(l)} + 2H_2O_{(l)} \longrightarrow PbO_{2(s)} + 4HCl_{(g)}$ e.t

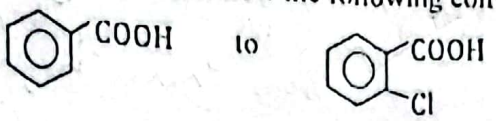
(c) Name the type of reaction that occurs in (b). (½ mark)

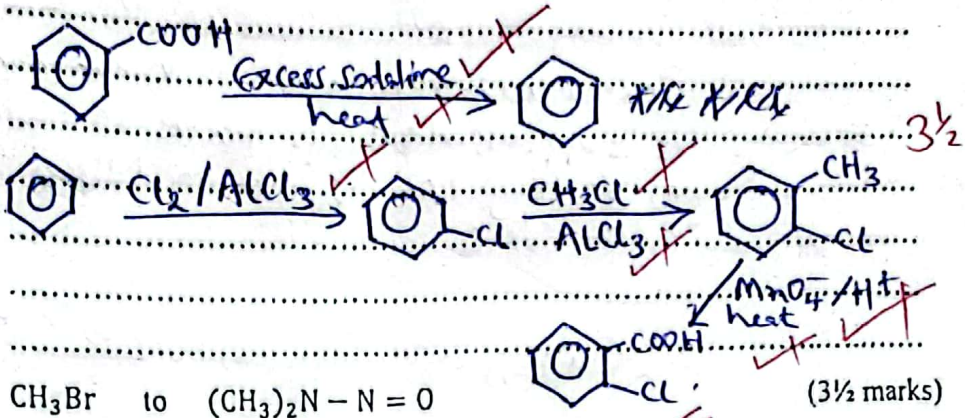
Hydrolysis ½

SECTION B (54 MARKS)

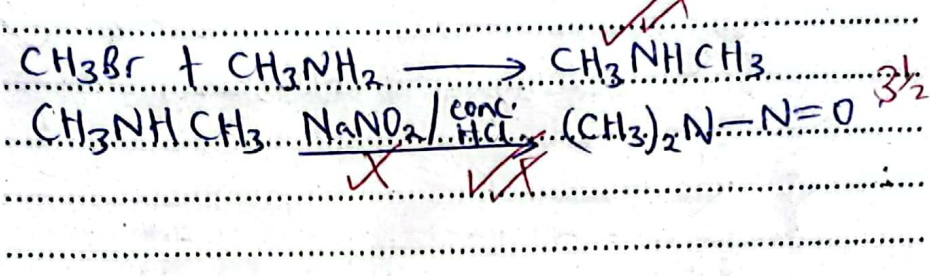
Attempt any six questions from this section.

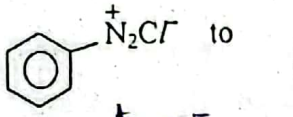
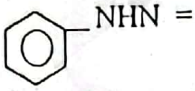
10. Write equations to show how the following conversions can be effected.

(a)  to (3½ marks)

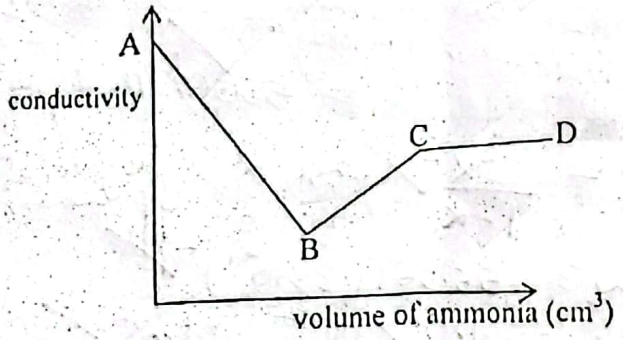


(b) CH_3Br to $(CH_3)_2N-N=O$ (3½ marks)



(c)  to  (02marks)

11. (a) 0.05M copper (II) sulphate was titrated with aqueous ammonia.
The conductivity of the mixture varies as shown by the graph below.



State the reason(s) why;

(i) conductivity is initially high at point A. (01 mark)

Copper (II) sulphate is a strong electrolyte 01
which ionises completely to give many copper (II)
ions and sulphate ions hence high conductivity.

(ii) conductivity almost remains constant along CD. (01 mark)

The ionisation of weak ammonia solution 01
is suppressed by presence of a common ion (hydroxide
ion) shifting the equilibrium $NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH_4^+ + OH_{(aq)}^-$
to the left.

(b) Write an equation for the reaction that takes place along;

(i) AB (01 mark)

$Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Cu(OH)_{2(s)}$ 01

(ii) BC (01 mark)

$Cu(OH)_{2(s)} + 4NH_{3(aq)} \longrightarrow Cu(NH_3)_4^{2+}_{(aq)} + 2OH^-_{(aq)}$ 01

(c) The electrolytic conductivity of water at 25°C is $5.484 \times 10^{-8}\ \Omega^{-1}cm^{-1}$ and its concentration is 18 g per 18 cm^3. Given that the molar conductivity at infinite dilution of H^+ and $\bar{O}H$ are 349.8 and 198.6 $\Omega^{-1}cm^2mol^{-1}$ respectively. Calculate the;

(i) degree of ionization of water at 25°C. (3½ marks)

$\Lambda_o H_2O = \Lambda_o H^+ + \Lambda_o \bar{O}H$

$= 349.8 + 198.6$

$= 548.4\ \Omega^{-1}cm^2mol^{-1}$ ✓

$\Lambda_c = \frac{1000K}{C}$ ✓

18 g of H_2O contain 1 mole

18 cm^3 of H_2O contain 1 mole

1000 cm^3 of H_2O contain $\left(\frac{1}{18} \times 1000\right)$ moles

$= 55.56$ moles/L ✓

$\Lambda_c = \frac{1000 \times 5.484 \times 10^{-8}}{55.56}$ ✓

$\Lambda_c = \frac{5.484 \times 10^{-5}}{55.56}$ ✓

$\Lambda_c = 9.87 \times 10^{-7}\ \Omega^{-1}cm^2mol^{-1}$

$\alpha = \frac{\Lambda_c}{\Lambda_o}$ ✓ $\alpha = \frac{9.87 \times 10^{-7}}{548.4}$

$\alpha = 1.8 \times 10^{-9}$ ✓ 3½

(ii) ionic product of water, Kw at 25°C. (1½ marks)

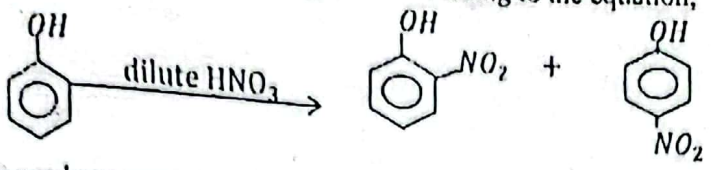
$Kw = C^2\alpha^2$ ✓ where α is degree of ionisation of water.

$Kw = 55.56^2(1.8 \times 10^{-9})^2$ ✓

$Kw = 1.0 \times 10^{-14}\ mol^2dm^{-6}$ ✓ 1½

09

12. Dilute nitric acid reacts with phenol according to the equation;



The products were separated by steam distillation.

(a) State the reason(s) why the;

(i) reaction occurs with dilute nitric acid in the absence of a catalyst unlike with benzene. (02 marks)

In phenol unlike benzene, presence of a hydroxyl group activates the benzene ring due to increased number of delocalised electrons making it more susceptible to electrophillic attack hence reaction with nitric acid in absence of a catalyst. 02

(ii) two products can be separated by steam distillation. (02 marks)

It's because 4-nitrophenol is non volatile (has a very high boiling point) owing to the strong intermolecular hydrogen bonds which can't easily be broken hence it can be separated from the volatile 2-nitrophenol which is also immiscible with water by steam distillation 02

(b) When the mixture was steam distilled at 1.0 atm at 96°C, the mass of water in the steam distillate was 0.90 g. Calculate the mass of the second component of the distillate.
(Saturated vapour pressure of water at 96°C = 0.825 atm). (03 marks)

Second component is 2 nitrophenol

R.F.M of  $= 12\times6+14+1+16\times3+4$
$= 139$

$P^\circ x = 1.0 - 0.825$
$= 0.175$ atm

$\frac{M_{H_2O}}{M_x} = \frac{P^\circ_{H_2O} \cdot Mr_{H_2O}}{P^\circ x \cdot Mr\,x}$

$\frac{0.90}{Mx} = \frac{0.825 \times 18}{0.175 \times 139}$

$Mx = \frac{0.90 \times 0.175 \times 139}{0.825 \times 18}$

$Mx = 1.474$g 03

(c) State two advantages of steam distillation. (02 marks)

- It is useful in purifying organic compounds which tend to decompose near their boiling points.
- It prevents thermal decomposition of compounds which occurs at high temperature. 02

09

13. (ii) Name one reagent that can be used to distinguish between the following pairs of compounds. State what would be observed when each member of the pair is separately treated with the reagent you have named.

(i) $K_2SO_{4(aq)}$ and $K_3PO_{4(aq)}$ (02 marks)

Reagent

Lead (II) nitrate solution and dilute nitric acid ✓

Observation

K_2SO_4: white precipitate insoluble in acid ✓ ✓ 02

K_3PO_4: white precipitate soluble in acid ✓

(ii) $NaCl_{(aq)}$ and $Na_2C_2O_{4(aq)}$ (02 marks)

Reagent

Calcium chloride solution ✓

Observation

NaCl: No observable change ✓ ✓ 02

$Na_2C_2O_4$: White precipitate ✓ ✓

(b) Explain each of the following observations.

(i) When sodium hydroxide solution is added to neutral potassium dichromate solution, the orange solution turns yellow and pale yellow precipitate is formed on addition of lead (II) nitrate solution.

(2½ marks)

In presence of sodium hydroxide solution, potassium dichromate solution is converted to potassium chromate (VI) solution ✓ which is yellow. ✓ 2½

On addition of lead (II) nitrate solution, yellow ✓ lead chromate (VI) ✓ is formed which is a yellow precipitate. ✓

$Pb^{2+}_{(aq)} + CrO^{2-}_{4(aq)} \longrightarrow PbCrO_{4(s)}$ ✓

(ii) Manganese (II) sulphate solution in the presence of concentrated nitric acid forms a purple solution on addition of sodium bismuthate.

(2½ marks)

$2Mn^{2+}_{(aq)} + 5BiO^{-}_{3(aq)} + 14H^{+}_{(aq)} \rightarrow 2MnO^{-}_{4(aq)} + 5Bi^{3+}_{(aq)} + 7H_2O_{(l)}$ ✓

Bismuthate (V) ions oxidise ✓ manganese (II) ions ✓ in manganese (II) sulphate solution to manganate (VII) ✓ ions which are purple in colour. ✓ 2½

09

14. An organic compound Q has a molecular formula; $C_4H_8O_2$ Corrected from C_4H_8O to $C_4H_8O_2$

Q has the following chemical properties;

- forms a yellow precipitate with both 2,4-dinitrophenyl hydrazine and aqueous Iodine in the presence of sodium hydroxide.
- forms a cloudy solution after 8 minutes on addition of a solution of anhydrous zinc chloride in concentrated hydrochloric acid.
- gives a silver mirror on addition of ammoniacal silver nitrate solution.

(a) Write the;

(i) structural formula of Q. (01 mark)

$CH_3CH(OH)CH_2CHO$ ✓ 01

(ii) IUPAC name of Q. (01 mark)

3-hydroxybutanal. ✓ 01

(b) Write an equation for the reaction between Q and;

(i) anhydrous zinc chloride in the presence of concentrated hydrochloric acid. (01 mark)

$CH_3CH(OH)CH_2CHO \xrightarrow{anhydrous\ ZnCl_2/HCl} CH_3CH(Cl)CH_2CHO + H_2O$ ✓ 01

(ii) ammoniacal silver nitrate solution. (01 mark)

$CH_3CH(OH)CH_2CHO + 2Ag(NH_3)_2^+_{(aq)} + 2OH^-_{(aq)} \rightarrow CH_3CH(OH)CH_2COONH_{4(aq)} + 2Ag_{(s)} + 3NH_{3(aq)} + H_2O_{(l)}$ 01

(iii) saturated sodium hydrogensulphite solution (01 mark)

$CH_3CH(OH)CH_2CHO + NaHSO_3 \rightarrow CH_3CH(OH)CH_2C(OH)(H)SO_3^-Na^+$ ✓ 01

(c) Suggest a suitable mechanism for the reaction between Q and acidified 2,4-dinitrophenyl hydrazine. (04 marks)

$CH_3CH(OH)CH_2CHO + 2,4\text{-}(O_2N)_2C_6H_3NHNH_2 \xrightarrow{H^+} 2,4\text{-}(O_2N)_2C_6H_3NHN{=}CHCH_2CH(OH)CH_3$ ✓ 04

Let $2,4\text{-}(O_2N)_2C_6H_3NO_2$ be P.

$CH_3CH(OH)CH_2C(=O)H \xrightarrow{H^+} CH_3CH(OH)CH_2C(OH)H \rightarrow CH_3CH(OH)CH_2C(OH)H$ (P–NHNH$_2$)

Turn Over

$CH_3CH(OH)CH_2C(OH_2^+)H \xrightarrow{H^+\ shift} CH_3CH(OH)CH_2C(NH)NH\text{-}P \xrightarrow{-H_2O} CH_3CH(OH)CH_2C{=}N\text{-}NH\text{-}P \xrightarrow{-H^+} CH_3CH(OH)CH_2C{=}N\text{-}N\text{-}P$

$CH_3CH(OH)CH_2C{=}N\text{-}N\text{-}P$ (P = $2,4\text{-}(O_2N)_2C_6H_3NHN{=}CHCH_2CH(OH)CH_3$)

09

15. (a) Ammonia is obtained on large scale in the Haber process according to the equation.

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \quad \Delta H = -92\ KJ$

State the effect of the following on the yield of ammonia. Give a reason for your answer.

(i) high pressure of 150 – 200 atm. (1½ marks)

...The forward reaction occurs with a decrease in volume (moles) hence favoured by high pressure which shifts equilibrium position to the right to form more ammonia increasing its yield.

(ii) high temperature above 450°C (1½ marks)

...The forward reaction is exothermic and hence favoured by low temperature. Increasing temperature above 450°C favours the backward reaction hence decreasing the yield of ammonia.

(b) 3.0 moles of nitrogen gas were mixed with 1.0 moles of hydrogen gas in a 500 cm^3 bulb. The mixture was allowed to attain equilibrium at 450°C and the mass of ammonia in the equilibrium mixture was found to be 0.34 g. Calculate the concentration equilibrium constant, Kc at 450°C. (03 marks)

Moles of $NH_3 = \frac{0.34}{17} = 0.02$ moles

Moles of $N_2 = 3 - 3(0.01) = 2.97$ moles

$H_2 = 1 - 0.01 = 0.99$

$NH_3 = 0.02$

Volume $= 500\ cm^3 = 0.5\ dm^3$

	$N_{2(g)}$	+	$3H_{2(g)}$	$\rightleftharpoons$	$2NH_{3(g)}$
Initial moles	3		1		0
If x moles react	3x		x		2x
moles at equilibrium	3 − 3x		1 − x		2x

$\frac{2x}{2} = \frac{0.02}{2}$ $x = 0.01$

$[N_2] = \frac{2.97}{0.5} = 5.94\ moldm^{-3}$

$[H_2] = \frac{0.99}{0.5} = 1.98\ moldm^{-3}$

$[NH_3] = \frac{0.02}{0.5} = 0.04\ moldm^{-3}$

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

$K_c = \frac{0.04^2}{5.94 \times 1.98^3}$

$K_c = 3.47 \times 10^{-5}\ mol^{-2}dm^6$

03

(c) Write equations to show how the ammonia obtained from the Haber process can be converted to nitric acid. (03 marks)

$2NH_{3(g)} + 5O_{2(g)} \rightarrow 2NO_{(g)} + 3H_2O_{(l)}$

$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

$4NO_{2(g)} + O_{2(g)} + 2H_2O_{(l)} \rightarrow 4HNO_{3(aq)}$

03

09

16. (a) Lithium belongs to group I of the Periodic Table but its properties resemble Magnesium of group II. State three;

(i) reasons why the chemistry of Lithium differs from other group I elements. (1½ marks)

- Has very small atomic radius
- Has very high electropositivity
- Lithium ion has very high polarizing power.
- Lithium has very low electronegativity

(ii) properties of lithium to show how its chemistry resembles that of Magnesium. (03 marks)

- Both Lithium and magnesium react with oxygen in air to form normal oxides
- Both form carbonates that decompose on heating
- Both form nitrates that decompose on heating to form normal oxides

03

(b) Write an equation for the reaction between;

(i) Magnesium nitride and water. (1½ marks)

$Mg_3N_{2(s)} + 6H_2O_{(l)} \longrightarrow 3Mg(OH)_{2(s)} + 2NH_{3(g)}$ 1½

(ii) Beryllium chloride and sodium hydroxide solution. (1½ marks)

$BeCl_{2(aq)} + 2NaOH_{(aq)} \longrightarrow Be(OH)_{2(s)} + 2NaCl_{(aq)}$ 1½

(iii) Barium peroxide and dilute hydrochloric acid. (1½ marks)

$BaO_{2(s)} + 2HCl_{(aq)} \longrightarrow BaCl_{2(aq)} + H_2O_{2(aq)}$ 1½

09

17. (a) Ethanol and hexane form an azeotropic mixture of composition 38.42% ethanol and 61.58% hexane. The density of the azeotrope is 0.687 gcm^{-3}.

Substance	Ethanol	Hexane	Azeotrope
Boiling point (°C)	78.4	68.9	59.15

(i) State the type of deviation from Raoult's law. (01 mark)

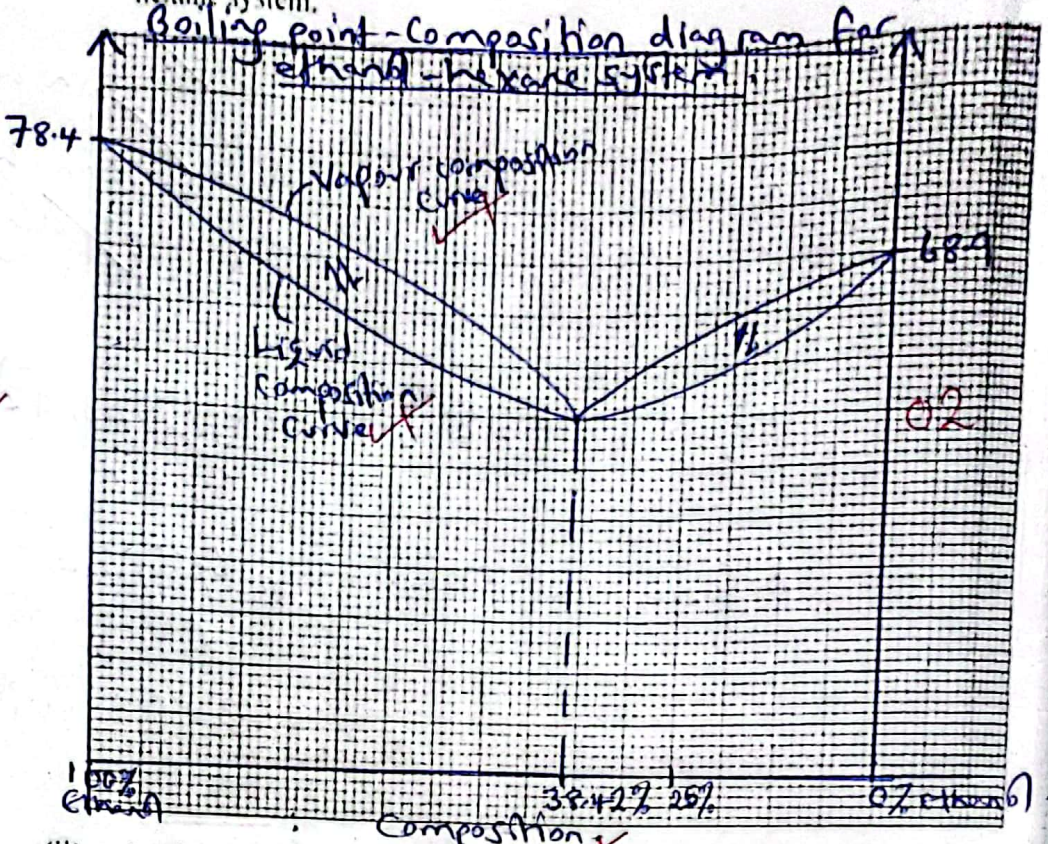
Positive deviation. 01

(ii) Explain your answer in (a)(i) above. (02 marks)

The mixture forms an azeotrope with minimum boiling point hence it contributes more vapour than expected from Raoult's law due to the very weak forces of attraction between the components hence positive deviation. 02

Turn Over

(b) (i) Sketch a well-labelled boiling point composition diagram for the ethanol-hexane system. (02 marks)



(ii) A mixture containing 25% liquid ethanol was fractionally distilled. Identify the substance obtained as;

- distillate... Azeotrope ... ½ ..... (½ mark)
- residual liquid... Pure hexane ... ½ ..... (½ mark)

(c) 50 cm^3 of the azeotrope was shaken with 100 cm^3 of choline chloride (solvent) at 25°C. Calculate the mass of ethanol extracted by choline solvent. (Partition coefficient of ethanol between choline chloride and hexane at 25°C is 15.80). (03 marks)

Let the mass of ethanol extracted by choline chloride be x.

1 cm^3 of azeotrope contains 0.687g

50 cm^3 of azeotrope contains $\frac{0.687 \times 50}{1}$ g

$= 34.35$ g

% ethanol $= \frac{38.42}{100} \times 34.35$

$= 13.197$ g

$K.D = \frac{[\text{ethanol}]_{\text{choline chloride}}}{[\text{ethanol}]_{\text{hexane}}}$

$15.80 = \frac{\frac{x}{100}}{\frac{13.197 - x}{50}}$

$15.80 = \frac{x}{100} \times \frac{50}{13.197 - x}$ 03

$15.80 = \frac{x}{2(13.197 - x)}$

$417.0252 - 31.6x = x$

$\frac{417.0252}{32.6} = \frac{32.6x}{32.6}$

$x = 12.792$ g of ethanol 04

09

THE PERIODIC TABLE

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

57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152	63 Sm 150	64 Eu 152	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf 251	99 Es (254)	100 Fm (257)	101 My (256)	102 No (254)	103 Lw

1. 1 ← Indicates atomic number.
   II

2. II
   1.0 ← Indicates relative atomic mass.

END