PROPOSED MARKING GUIDE ✱ SSEMAKULA MUZAPHAR
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Candidate's Name: .....

Signature: .....

Random No.					Personal No.		

(Do not write your School /Centre Name or Number anywhere on this booklet.)

P525/1
CHEMISTRY
Paper 1
(Theory)
Nov./Dec. 2024
2¾ hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1
(Theory)

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of **two** *Sections;* **A** *and* **B**.

Section **A** *is* **compulsory**. *Attempt* **six** *questions from Section* **B**. *Any additional question(s) attempted will* **not** *be marked.*

All questions **must** *be answered in the spaces provided. Use* **blue** *or* **black** *ink. Any work done in pencil,* **except** *drawings, will not be marked.*

The Periodic Table, with relative atomic masses, is attached at the end of the paper.

Mathematical tables (3-figure tables) are adequate or silent non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

Where necessary, use the following:

Molar gas constant, $R = 8.31\ JK^{-1}\ mol^{-1}$.
Molar volume of gas at s.t.p. is 22.4 litres.
Standard temperature = 273 K.
Standard pressure = $101325\ Nm^{-2}$.

For Examiners' 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)

Answer **all** *the questions in this section.*

1. (a) Define the term **standard electrode potential.** *(01 mark)*

This is the reduction potential of an electrode or half cell measured against or using a standard hydrogen electrode under standard conditions. ✓ (01)

(b) The standard electrode potentials of some half cells reactions are given below:

	E^{θ} (V)
$Co^{2+}_{(aq)} + 2e \longrightarrow Co_{(s)}$	−0.28
$Zn^{2+}_{(aq)} + 2e \longrightarrow Zn_{(s)}$	−0.76
$Cl_{2\,(aq)} + 2e \longrightarrow 2\,Cl^{-}_{(aq)}$	+1.36
$MnO^{-}_{4\,(aq)} + 8H^{+}_{(aq)} + 5e \longrightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$	+1.52

(i) Identify the strongest reducing agent and the strongest oxidising agent. *(01 mark)*

Strongest reducing agent is zinc ✓

Strongest oxidizing agent is manganate(VII) ion ✓ (01)

(ii) Write the cell notation of the cell constructed by combining the half cells $Co^{2+}_{(aq)} / Co_{(s)}$ and $Zn^{2+}_{(aq)} / Zn_{(s)}$. *(01 mark)*

$Zn_{(s)} / Zn^{2+}_{(aq)} \,||\, Co^{2+}_{(aq)} / Co_{(s)}$ ✓ 01

(iii) Write the equation for the overall cell reaction for the cell in b(ii). *(01 mark)*

$Zn_{(s)} + Co^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Co_{(s)}$ ✓ 01

(iv) Calculate the e.m.f. of the cell in b(ii).. *(01 mark)*

$E^{\theta}_{cell} = E^{\theta}_{Right} - E^{\theta}_{Left}$ 01

$= -0{\cdot}28 - (-0{\cdot}76)$ ✓ $= +0{\cdot}48\ V$ ✓ Deduct ½ IF + IS missing

2. Nylon 6, 6 $\left[\begin{matrix}H\\|\\N\end{matrix}-(CH_2)_6-\begin{matrix}H\\|\\N\end{matrix}-\begin{matrix}O\\\|\\C\end{matrix}-(CH_2)_4-\begin{matrix}O\\\|\\C\end{matrix}\right]_n$ is formed by condensation polymerisation.

(a) State the meaning of the term condensation polymerisation. *(01 mark)*

This is the combination of two types of bifunctional group monomers (molecules) to form a large molecule with elimination of small molecules.

Reject simple molecules

(b) (i) Write the structural formula(e) and name(s) of the monomers of nylon 6, 6. *(03 marks)*

$H_2N(CH_2)_6NH_2$ - Hexane-1,6-diamine. Rej $H_2N-(CH_2)_6$

$HOOC(CH_2)_4COOH$ - Hexane-1,6-dioic acid. (03)

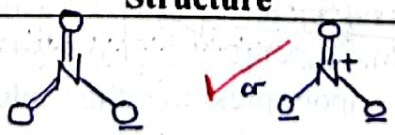
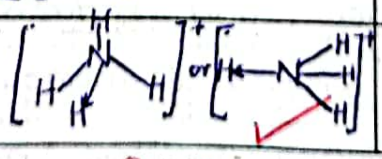
Accept $ClOC(CH_2)_4COCl$ - Hexanedioyl dichloride Rej $HOOC-(CH_2)_4$

(ii) State **one** use of nylon 6, 6. *(01 mark)*

- Making fabrics / clothes or - Making fish nets.

3. Draw the structure and name the shape of each of the following ions in Table 1: *(4½ marks)*

Table 1

Ion	Structure	Name of shape
NO_3^-		Trigonal planar.
SO_3^{2-}		Trigonal pyramidal.
NH_4^+		Tetrahedral.

check bonds should be in close proximity or touching

Reject if charge is missing

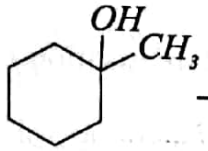
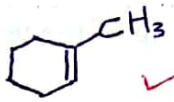
4½

4. Complete the following equations and name the major organic product:

(a) $CH_3COOH \xrightarrow{PCl_5}$ CH_3COCl ✓ 01 ..... (1½ marks)

Name ..... Ethanoyl chloride ✓ ½ .....

Reject Ethanoylchloride

(b)  $\xrightarrow[Heat]{Al_2O_3}$  ✓ 01

..... (1½ marks)

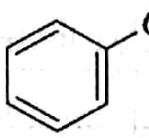
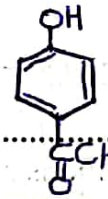
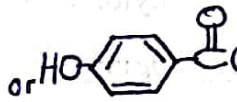
Name ..... 3-Methylcyclohexene ✓ ½ .....

Reject Methylcyclohexene

(c) $(CH_3COO)_2Ca \xrightarrow{Heat}$ CH_3COCH_3 ✓ or CH_3COCH_3 01

..... (1½ marks)

Name ..... Propanone ✓ ½ .....

(d)  $\xrightarrow[AlCl_3]{CH_3COCl}$  or  ✓ 01

..... (1½ marks)

Name ..... 4-Hydroxyphenylethanone ✓ ½ .....

5. The vapour pressure of propanone is 37330 Nm^{-2} at 30 °C. When 33.4 g of cane sugar were dissolved in 120 g of propanone, the vapour pressure reduced by 1760 Nm^{-2}.

(a) Calculate the molar mass of cane sugar. (2½ marks)

Molar mass of CH_3COCH_3

$= (3\times12)+(6\times1)+(1\times16)$

$= 58g$ ✓

$\frac{\Delta P}{P^o} = \frac{m_{sugar} \times Mr_{CH_3COCH_3}}{Mr_{sugar} \times m_{CH_3COCH_3}}$ ✓

$\frac{1760}{37330} = \frac{33.4 \times 58}{Mr_{sugar} \times 120}$ ✓

$Mr_{sugar} = 342.4038g$ ✓ (2½)

∴ The molar mass of cane sugar is 342.4038 g .

(b) Explain why the vapour pressure of the solution is lower than that of propanone. (1½ marks)

Cane sugar is a non-volatile solute ✓. It covers part of propanone surface, and reduces the escaping ✓ tendency of propanone molecules into vapour (1½) phase. The solution therefore exerts a lower vapour pressure than pure propanone.

6. (a) State what would be observed and write an equation for the reaction that takes place when dilute hydrochloric acid is added to aqueous potassium manganate(VI) solution.

Observation: *(1½ marks)*

The green solution turns purple and a black precipitate (dark brown) is formed. (1½)

Equation: *(1½ marks)*

$3MnO_4^{2-}(aq) + 4H^+(aq) \longrightarrow 2MnO_4^-(aq) + MnO_2(s) + 2H_2O(l)$ (1½)

Or $3K_2MnO_4(aq) + 4HCl(aq) \longrightarrow 2KMnO_4(aq) + MnO_2(s) + 4KCl(aq) + 2H_2O(l)$

(b) Explain why potassium manganate(VII) is **not** acidified using hydrochloric acid. *(2½ marks)*

Potassium manganate(VII) is a powerful oxidizing agent therefore oxidizes hydrochloric acid to chlorine gas.

$2MnO_4^-(aq) + 16H^+(aq) + 10Cl^-(aq) \longrightarrow 2Mn^{2+}(aq) + 5Cl_2(g) + 8H_2O(l)$ (2½)

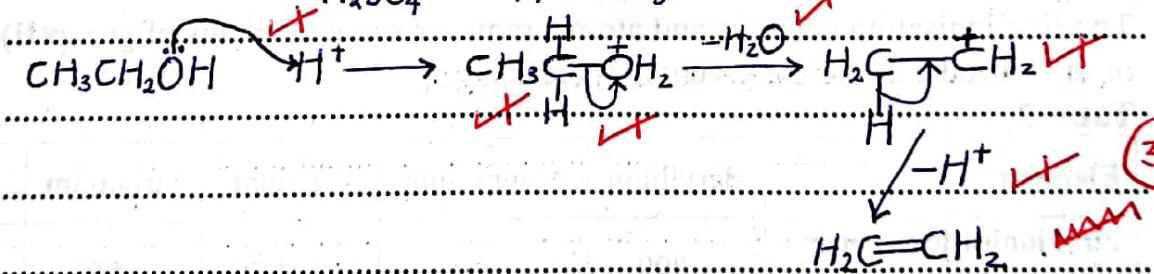
Or $2KMnO_4(aq) + 16HCl(aq) \longrightarrow 2MnCl_2(aq) + 2KCl(aq) + 5Cl_2(g) + 8H_2O(l)$

7. Complete the following equations and in each case write the mechanism for the reaction(s):

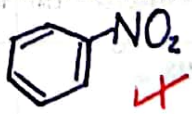
(a) $CH_3CH_2OH \xrightarrow[180\ ^\circ C]{Conc.H_2SO_4}$ $H_2C{=}CH_2 + H_2O$ *(3½ marks)*

Mechanism:

$H_2SO_4 \rightleftharpoons H^+ + \bar{O}SO_3H$

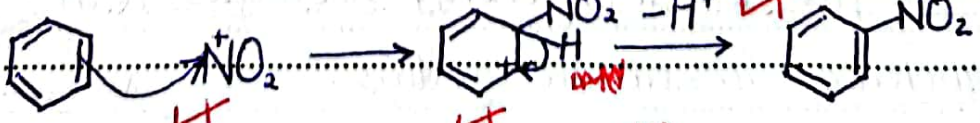


(3½)

(b)  $\xrightarrow{Conc.\ HNO_3/Conc.H_2SO_4}$  *(2½ marks)*

Mechanism:

$HNO_3 + 2H_2SO_4 \longrightarrow \overset{+}{N}O_2 + H_3\overset{+}{O} + 2HSO_4^-$



(2½)

Accept 

8. (a) Write an equation for the reaction that takes place when methylamine is dissolved in water. *(1½ marks)*

$CH_3NH_{2(aq)} + H_2O_{(l)} \rightleftharpoons CH_3\overset{+}{N}H_{3(aq)} + \bar{O}H_{(aq)}$ ✓ ✓ (1½)

(b) The hydrogen ion concentration of a 1M methylamine solution is 2.5×10^{-13} *mol* l^{-1}. Calculate the base dissociation constant K_b, of methylamine. *(3½ marks)*

(The ionic product of water, $K_w = 10^{-14}$ *mol*^{2} l^{-2}*)*

$K_b = \dfrac{[CH_3\overset{+}{N}H_3][\bar{O}H]}{[CH_3NH_2]}$ ✓

At equilibrium ; $[CH_3\overset{+}{N}H_3] = [\bar{O}H]$ ✓

$K_b = \dfrac{[\bar{O}H]^2}{[CH_3NH_2]}$ ✓

$[\bar{O}H] = \dfrac{K_w}{[H^+]} = \dfrac{10^{-14}}{2.5 \times 10^{-13}}$ ✓

$[\bar{O}H] = 0.04\ mol\,l^{-1}$ ✓

$K_b = \dfrac{(0.04)^2}{1}$ ✓ (3½)

$= 0.0016\ mol\,l^{-1}$ ✓

9. The first ionisation energies and atomic radii for some elements of group(II) of the Periodic Table are given in Table **2**.

Table 2

Element	Beryllium	Magnesium	Calcium	Strontium	Barium
First ionisation energy (kJ mol^{-1})	899	738	590	550	503
Atomic radius (nm)	0.089	0.136	0.174	0.191	0.198

(a) State how the first ionisation energy varies with atomic radius. *(01 mark)*

The first ionisation energy decreases with increase in atomic radius. ✓ 01

(b) Explain your answer in (a). *(04 marks)*

From beryllium to barium, nuclear charge increases as protons are added to the nucleus. The screening effect also increases due to increase in the number of complete inner energy levels of electrons. Increase in screening effect outweighs the increase in nuclear charge, therefore the effective nuclear charge decreases, atomic radius increases and outermost electron is far and weakly attracted by the nucleus hence low amount of energy is required to remove it. (04)

SECTION B: (54 MARKS)

Answer any **six** *questions from this section.*
Any additional question(s) answered will **not** *be marked.*

10. The molecular formula of a compound ***P*** is $C_3H_6Cl_2$.

(a) Write the structural formulae of all the possible isomers of *P*. *(02 marks)*

$CH_3CH_2\overset{H}{\overset{|}{C}}Cl_2$ $\quad CH_3\overset{Cl}{\overset{|}{C}}HCH_2Cl$

$CH_3\overset{Cl}{\overset{|}{\underset{Cl}{\overset{|}{C}}}}CH_3$ $\quad ClCH_2CH_2CH_2Cl$ (02)

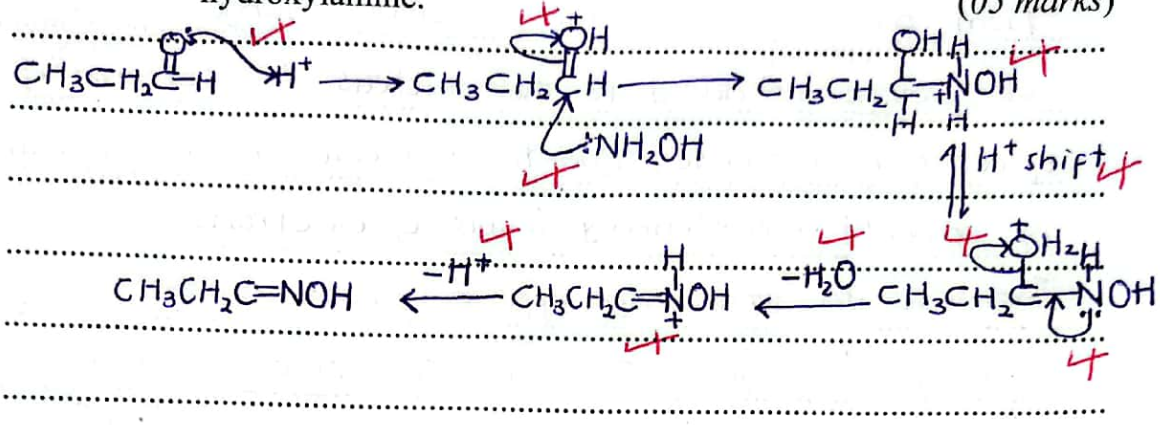
(b) When ***P*** was boiled with aqueous sodium hydroxide, a compound ***R*** which reacted with hydroxylamine (NH_2OH) in the presence of an acid and reduced Fehling's solution, was formed.

(i) Identify compounds ***P*** and ***R***. *(02 marks)*

P is 1,1-Dichloropropane or $CH_3CH_2CHCl_2$

R is Propanal or $CH_3CH_2\overset{O}{\overset{\|}{C}}-H$ (02)

(ii) Write a mechanism for the reaction between ***R*** and hydroxylamine. *(05 marks)*



11. (a) State **two** factors which affect the magnitude of lattice energy. *(01 mark)*

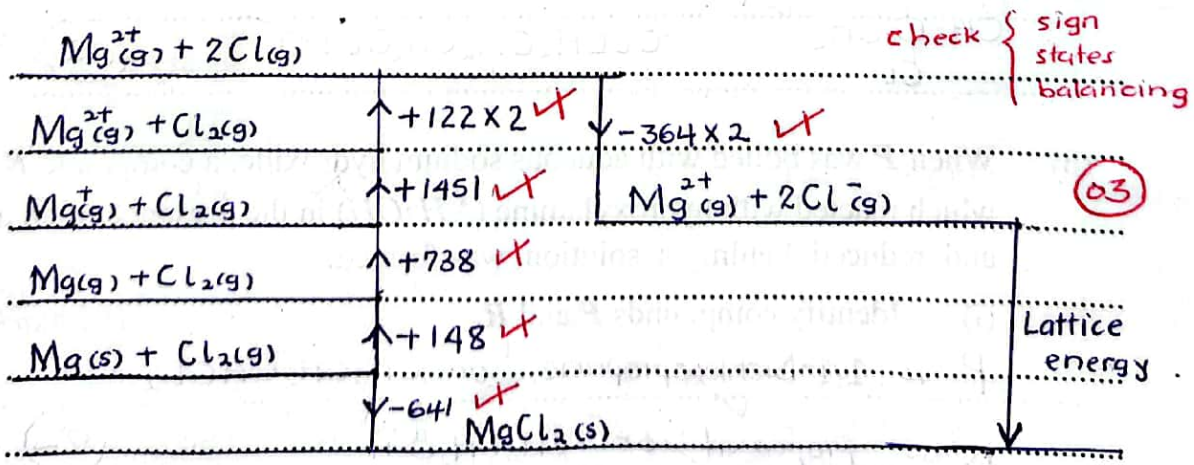
Magnitude of Ionic charge ✓ 01 Emphasize spelling.

Ionic radius ✓

(b) Some thermochemical data are shown below:

Enthalpy of atomisation of chlorine = +122 kJ mol^{-1}.
Enthalpy of atomisation of magnesium = +148 kJ mol^{-1}.
First ionisation energy of magnesium = +738 kJ mol^{-1}.
Second ionisation energy of magnesium = +1451 kJ mol^{-1}.
Enthalpy of formation of magnesium chloride = −641 kJ mol^{-1}.
First electron affinity of chlorine = −364 kJ mol^{-1}.

(i) Construct an energy level diagram for the formation of magnesium chloride. *(03 marks)*



(ii) Determine the lattice energy of magnesium chloride. (*02 marks*)

$-641 = +148+738+1451+(122\times2)+(-364\times2)$ + Lattice energy

Lattice energy = $-1,188\ kJmol^{-1}$ with units (02)

$-\frac{1}{2}$ with no units

0 for wrong units

(iii) Calculate the enthalpy of solution of magnesium chloride. (*03 marks*)

(*The hydration energies of magnesium ions and chloride ions are −1891 and −381 kJ mol^{-1} respectively.*)

$\Delta H_{Hydration(MgCl_2)} = \Delta H_{Hydration}(Mg^{2+}) + 2\Delta H_{Hydration}(Cl^-)$

$= -1891 + (2\times-381)$

$= -2,653\ kJmol^{-1}$

Enthalpy of solution = $\Delta H_{hydration}(MgCl_2) + \Delta H_{Lattice}(MgCl_2)$

$= -2,653 + 1,188$

$= -1,465\ kJmol^{-1}$ (03)

12. (a) One of the characteristics of transition elements, is formation of complexes. Explain how transition metal ions form complexes. (*1½ marks*)

Transition metal ions have small ionic radii and high charge density which attract strongly the lone pairs of electrons from molecules or negatively charged ligands. They also have vacant d orbitals which can accommodate lone pairs of electrons from ligands. (1½)

(b) The formulae of some complex ions are shown in Table **3**. Write the name of the complex ion, its oxidation state and the co-ordination number of the central metal ion. (*03 marks*)

Table 3

Complex ion	Name of ion	Oxidation state	Co-ordination number
$[(Co\ (SCN)_4]^{2-}$	Tetrathiocyanatocobaltate(II)	+2	4
$[Cr\ (NH_3)_4Cl_2]^{+}$	Tetraamminedichlorochromium(III)	+3	6

(03)

(c) The molecular mass of a salt, $Cu\ (NH_3)_x\ Cl_y \cdot ZH_2O$ is 276.

When a solution containing 1.38 g of salt was reacted with excess silver nitrate solution, 2.87 g of silver chloride was formed.

Calculate the number of moles of chloride ions in 1 mole of the salt. (*02 marks*)

Molar mass of AgCl
= (108 × 1) + (35·5 × 1) = 143·5 g ✓

143·5 g of silver chloride contain 1 mole
2·87 g of silver chloride contain $\left(\frac{1 \times 2{\cdot}87}{143{\cdot}5}\right)$ moles
= 0·02 moles ✓

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

1 mole of silver chloride is produced by 1 mole of chloride ions
0·02 moles of silver chloride is produced by 0·02 moles of chloride ions

276 g of the salt contain 1 mole
1·38 g of the salt contain $\left(\frac{1 \times 1{\cdot}38}{276}\right)$ moles ✓
= 0·005 moles

0·005 moles of the salt contain 0·02 moles of chloride ions.
1 mole of the salt contain $\left(\frac{0{\cdot}02}{0{\cdot}005}\right)$ moles of chloride ions
= 4 moles ✓

02

(d) When a solution containing 1.38g of the salt was mixed with aqueous sodium hydroxide and heated, the ammonia liberated completely neutralised 10 cm^3 of a 1.0 M hydrochloric acid.

Calculate the number of moles of;

(i) ammonia molecules in 1 mole of the salt. *(1½ marks)*

Moles of hydrochloric acid that reacted
1000 cm^3 of solution contain 1 mole of the acid
10 cm^3 of solution contain $\left(\frac{1}{1000} \times 10\right)$ moles of the acid
= 0·01 moles ✓

$NH_{3(aq)} + HCl_{(aq)} \longrightarrow NH_4Cl_{(aq)}$

Moles of ammonia liberated = 0·01 mole

0·005 moles of the salt liberated 0·01 mole of ammonia ✓
1 mole of the salt liberated $\left(\frac{0{\cdot}01}{0{\cdot}005}\right)$ moles of ammonia
= 2 moles ✓

1½

(ii) water in 1 mole of the salt. *(01 mark)*

$Cu(NH_3)_2Cl_4 \cdot zH_2O$

$63{\cdot}5 + (2 \times 14) + (6 \times 1) + (4 \times 35{\cdot}5) + z[(2 \times 1) + (16 \times 1)] = 276$ ✓

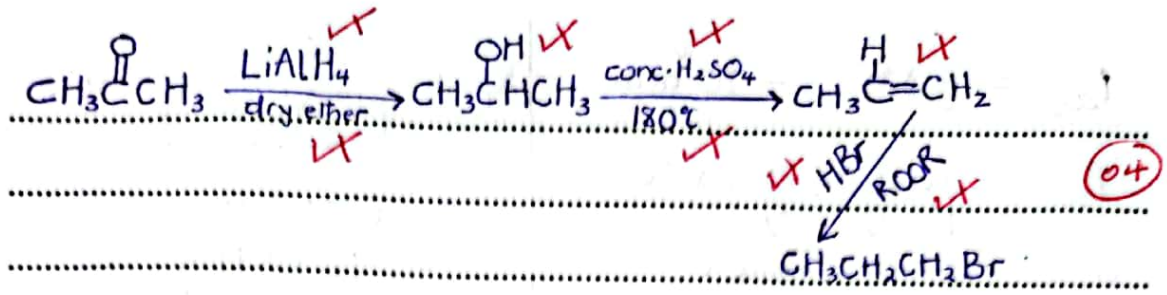
$z = 2$

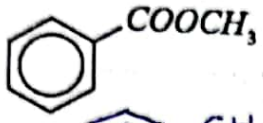
∴ The number of moles of water in 1 mole of the salt is 2. ✓

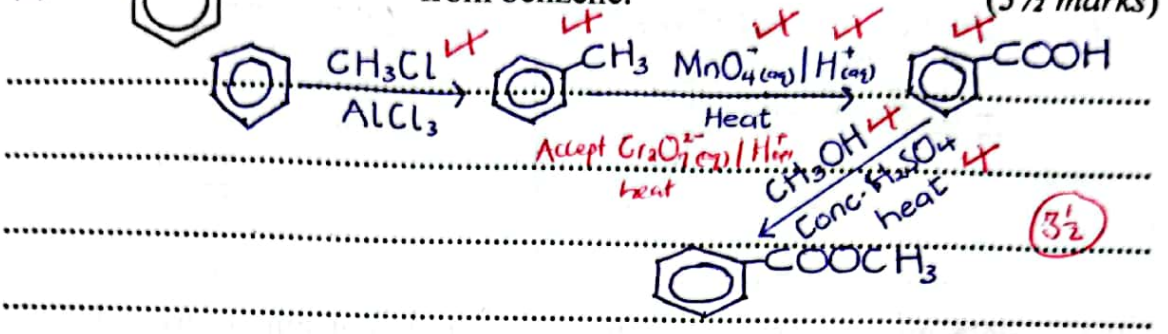
01

13. Write the equations to show how the following compounds can be synthesised and in each case, indicate the conditions for the reaction.

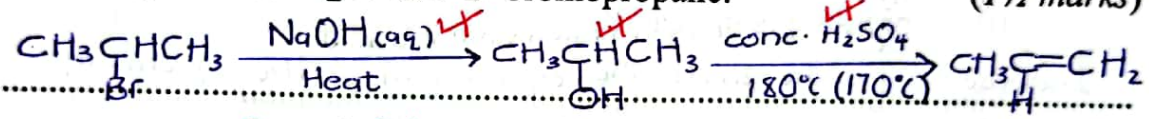
(a) $CH_3CH_2CH_2Br$ from propanone. *(04 marks)*



(b)  from benzene. *(3½ marks)*



(c) $CH_3CH=CH_2$ from 2–bromopropane. *(1½ marks)*



14. Sulphur dioxide and oxygen can react to form sulphur trioxide according to the following equation:

$2\,SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2\,SO_{3\,(g)}$; ΔH is negative.

3 moles of sulphur dioxide and 2 moles of oxygen were heated at 450 °C in a 1 dm^3 vessel at 50 atmospheres. At equilibrium the vessel contained 20 % sulphur dioxide.

(a) (i) Write the expression for the equilibrium constant, K_p. *(½ mark)*

$$K_p = \frac{(P_{SO_3})^2}{(P_{SO_2})^2 \cdot (P_{O_2})}$$ ½

(ii) Calculate the value of the equilibrium constant, K_p for the reaction at 450 °C. *(04 marks)*

Let x moles of O_2 react

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

	$2SO_{2(g)}$	$O_{2(g)}$	$2SO_{3(g)}$
Initial moles	3	2	0
Equilibrium moles	$3-2x$	$2-x$	$2x$

Total moles at equilibrium $= 3-2x+2-x+2x = 5-x$

$\frac{3-2x}{5-x} = \frac{20}{100}$

$x = 10/9$

Total moles $= 5 - 10/9 = 35/9$

$P_{SO_2} = \frac{1}{5} \times 50 = 10$ atms. ✓

$P_{SO_3} = \left[\frac{2 \times 10}{9} \div \frac{35}{9}\right] \times 50$ ✓

$= 28.5714$ atms.

$P_{O_2} = 50 - (10 + 28.5714)$

$= 11.4286$ atms. ✓

$K_p = \frac{(P_{SO_3})^2}{(P_{SO_2})^2 \cdot (P_{O_2})}$

$= \frac{(28.5714)^2}{10^2 \times 11.4286}$ ✓

$= 0.7142825\ atm^{-1}$ ✓

04

(b) State, giving reasons, how the concentration of sulphur trioxide at equilibrium would be affected if;

(i) pressure is increased. (1½ marks) ✓

Increase in pressure shifts the equilibrium position from left to right ✓ since the forward reaction proceeds with a decrease in volume. Therefore more sulphur dioxide and oxygen react to form ✓ sulphur trioxide which increases its concentration. (1½)

(ii) temperature is increased. (1½ marks)

The equilibrium position shifts from right to left. ✓ since the backward reaction is endothermic ✓, Sulphur trioxide decomposes to give sulphur dioxide and oxygen hence the concentration of sulphur trioxide decreases ✓ (1½)

(iii) an inert gas is added at constant pressure. (1½ marks)

Addition of an inert gas at constant pressure increases ✓ the systems volume thus the pressure of the system decreases ✓. Equilibrium position shifts from right to left ✓ and sulphur trioxide decomposes to give sulphur dioxide and oxygen. This results into decrease ✓ in concentration of sulphur trioxide. (1½)

15. (a) State the meaning of the term **bond energy**. *(01 mark)*

This is the amount of heat evolved when one mole of covalent bonds is formed from its free gaseous atoms 01

Or Amount of heat absorbed when one mole of covalent bonds is broken to form free gaseous atoms

Reject covalent bond in each case

(b) The bond dissociation energies of fluorine, chlorine, bromine and iodine are 158, 242, 193 and 151 kJ mol^{-1} respectively.

(i) State the trend in the bond dissociation energies of the elements. *(1½ marks)*

Bond dissociation energy decreases from chlorine to Iodine but with flourine having an abnormally low value of bond dissociation energy. 1½

(ii) Explain your answer in (b)(i). *(3½ marks)*

From chlorine to Iodine, atomic radius increases, bond length increases and bond strength decreases, resulting into weaker attraction between the atoms in the molecule. Hence amount of energy required to break the bonds decreases. Flourine has an abnormally low value of bond dissociation energy because it has the smallest atomic radius which makes the non-bonding electron pairs on the flourine atoms very close to each other causing a strong repulsion. This strong repulsion pushes the flourine atoms far apart weakening the flourine-flourine bond hence low amount of energy is required to break it. 3½

(c) Write an equation to show how cold dilute sodium hydroxide solution reacts with;

(i) fluorine. *(1½ marks)*

$2F_{2(g)} + 2NaOH_{(aq)} \longrightarrow OF_{2(g)} + 2NaF_{(aq)} + H_2O_{(l)}$ 1½

Or $2F_{2(g)} + 2\bar{O}H_{(aq)} \longrightarrow OF_{2(g)} + 2F^-_{(aq)} + H_2O_{(l)}$

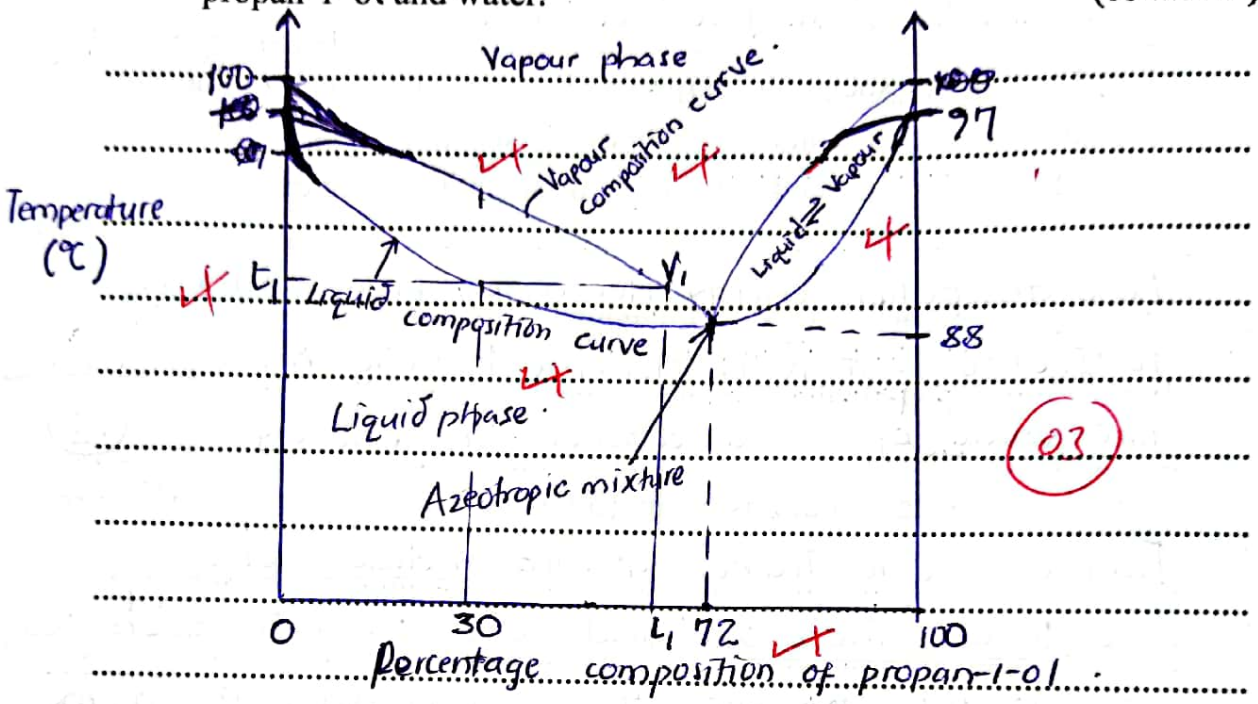
(ii) chlorine. *(1½ marks)*

$Cl_{2(g)} + 2NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + NaClO_{(aq)} + H_2O_{(l)}$

Or $Cl_{2(g)} + 2\bar{O}H_{(aq)} \longrightarrow Cl^-_{(aq)} + Cl\bar{O}_{(aq)} + H_2O_{(l)}$ 1½

16. Propan-1-ol (boiling point 97 °C) and water (boiling point 100 °C) are miscible in all proportions. A mixture of the two liquids containing 72 % propan-1-ol boils at 88 °C.

(a) Sketch a labelled boiling point–composition diagram for the mixture of propan-1-ol and water. *(03 marks)*



(b) Briefly explain;

(i) why propan-1-ol and water form a minimum boiling point mixture. *(04 marks)*

The mixture has a minimum boiling point because it deviates positively from Raoult's law. This is because forces of attraction between propan-1-ol molecules and water molecules are on average weaker than the forces of attraction between individual propan-1-ol molecules and the forces of attraction between individual water molecules. This increases the tendency for the molecules to escape from the solution than from the pure liquids. Therefore the total vapour pressure above the liquids will be greater than what is predicted by Raoult's law and this corresponds to a minimum boiling point.

(ii) what would happen when a mixture containing 30 % propan–1–ol is fractionally distilled. (02 marks)

When a mixture containing 30% propan-1-ol is heated, it boils at a temperature t_1°C to form a vapour of composition, V_1 containing a higher percentage of propan-1-ol than the solution. When the vapour is condensed, it forms a liquid l_1 of the same composition as the vapour, still richer in propan-1-ol. Repeated vapourization and distillation will yield the azeotropic mixture as the distillate and pure propan-1-ol as the residue. (02)

17. Tin and lead are elements in group(IV) of the Periodic Table. Describe the reactions of the elements with;

(a) cold water. (03 marks)

Tin does not react with cold water.

Lead reacts with cold soft water containing oxygen to form slightly soluble lead(II) hydroxide

$$2Pb(s) + 2H_2O(l) + O_2(g) \longrightarrow 2Pb(OH)_2(s)$$ (03)

(b) sodium hydroxide solution. (3½ marks)

Tin reacts with hot concentrated sodium hydroxide solution to form sodium stannate(IV) and hydrogen gas

$$Sn(s) + 2\bar{O}H(aq) + H_2O(l) \longrightarrow SnO_3^{2-}(aq) + 2H_2(g)$$ (3½)

Lead reacts with hot concentrated sodium hydroxide solution to form sodium plumbate(II) and hydrogen gas.

$$Pb(s) + 2\bar{O}H(aq) \longrightarrow PbO_2^{2-}(aq) + H_2(g)$$

(c) hot concentrated sulphuric acid. (2½ marks)

Hot concentrated sulphuric acid oxidizes both tin and lead to tin(IV) sulphate and lead(II) sulphate respectively and itself reduced to sulphur dioxide gas and water. (2½)

$$Sn(s) + 4H_2SO_4(aq) \longrightarrow Sn(SO_4)_2(aq) + 2SO_2(g) + 4H_2O(l)$$

$$Pb(s) + 2H_2SO_4(aq) \longrightarrow PbSO_4(s) + SO_2(g) + 2H_2O(l)$$