Candidate's Name: MUNICEH.....

Signature: .....

Random No.					Personal No.		

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

P525/1
CHEMISTRY
Paper 1
Nov./Dec. 2018
2¾ hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

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

All *questions must be answered in the spaces provided.*

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

Mathematical tables (3– figure tables) are adequate or 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** questions in this section.*

1. Various concentrations of **X** and **Y** were reacted at a constant temperature. The table below shows the initial concentrations of **X** and **Y** and their intitial rates for the reaction.

Experiment	[X] (mol dm^{-3})	[Y] (mol dm^{-3})	Initial rate (mol s^{-1})
1	0.2	0.2	3.5×10^{-4}
2	0.4	0.4	1.4×10^{-3}
3	0.8	0.4	5.6×10^{-3}

(a) State the order of reaction with respect to **X** and **Y**.

(i) **X** ..... 2 ✓ (1) Accept two 2 or second order ..... *(½ mark)*

(ii) **Y** ..... 0 ✓ (1) zero order. ..... *(½ mark)*

Accept calculation or .. for the orders

Expt 2 or 3

$2^x = 4$

$x = 2$.

$4 = 4 \times 2^y$

$1 = 2^y$

$y = 0$

(b) Give reasons for your answers in (a). *(02 marks)*

- Doubling concentration of X while keeping that of Y constant, the rate increases four times. ✓ ✓ (02)
- Doubling both concentration of X and Y the rate increases four times. ✓ ✓

(c) Determine the overall order of the reaction. *(½ mark)*

2 + 0 = 2. ✓ (1)

(d) Calculate the value for the rate constant for the reaction. *(1½ marks)*

Rate = $K[X]^2$ ✓

$3.5 \times 10^{-4} = K(0.2)^2$ ✓ (1½)

$K = 8.75 \times 10^{-3}$ ✓ Ignore units

Accept Rate = $K[X]^2[Y]^0$

Deny ½ mark if y.

Rate = $K(X)^2$

2. (a) A solid ***Q*** contains 9.37% by mass of magnesium, 10.39% nitrogen and 42.18% water. 06 k_2

(i) Calculate the empirical formula of ***Q***. *(02 marks)*

% of oxygen atoms = 100 − (9.37 + 10.39 + 42.18) = 38.06% ✓

All names were transferred to Qn 3.

Element / Compound	Mg	N	O	H_2O
Moles	$\frac{9.37}{24}$	$\frac{10.39}{14}$	$\frac{38.06}{16}$	$\frac{42.18}{18}$ ✓
	0.39	0.781	2.38	2.34 (02)
Mole ratio	$\frac{0.39}{0.39}$	$\frac{0.781}{0.39}$	$\frac{2.38}{0.39}$	$\frac{2.34}{0.39}$ ✓
	1	2	6	6

Empirical formular $MgN_2O_6(H_2O)_6$ ✓

(i) Determine the molecular formula of **Q**. *(01 mark)*
(RFM of Q = 256)

$24n + 28n + (16\times6)n + (18\times6)n = 256$ ✓+

$n = 1$ ✓+ (01)

Molecular formula is $Mg_5N_2O_6(H_2O)_6$ or $Mg_5N_2O_6 \cdot 6H_2O$

(b) Solution of **Q** reacts with iron(II) suphate in the presence of concentrated sulphuric acid to form a brown ring. Identify **Q**. *(½ mark)*

Magnesium nitrate hexahydrate or $Mg(NO_3)_2 \cdot 6H_2O$ ✓+

(c) Write equation for the reaction that would take place if **Q** was heated. *(1½ marks)*

$2Mg(NO_3)_2 \cdot 6H_2O_{(s)} \longrightarrow 2MgO_{(s)} + 4NO_{2(g)} + O_{2(g)} + 12H_2O$ ✓+ (1½)

5½

3. Name a reagent that can be used to distinguish between the following pairs of compounds.

In each case, state what would be observed if each member of the pair was treated with the reagent you have named.

(a) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}}\, C \equiv C\, CH_3$ and $CH_3CH_2\, \underset{\displaystyle CH_3}{\underset{|}{CH}}\, C \equiv CH$

Reagent *(01 mark)*

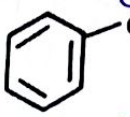
Ammoniacal silver nitrate solution ✓ | Ammoniacal copper(I) chlorid

Observation *(02 marks)*

$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}}\, C \equiv C\, CH_3$ — No observable change ✓ (03) | No observable change

$CH_3CH_2\, \underset{\displaystyle CH_3}{\underset{|}{CH}}\, C \equiv CH$ — White precipitate ✓ | Red precipitate.

rej: Reddish brown ppt

(b)  CHO and CH_3CHO

Reagent *(01 mark)*

Fehling solution ✓ (CuSO4 soln + NaOH soln + potassium tartrate) | Iodine solution and Sodium hydroxide solu

Accept with or without heat

Observation *(02 marks)*

 CHO — No observable change ✓ (03) | No observable change

CH_3CHO – Reddish brown ppt ✓ | Pale yellow precipitate

rej: Red or brown ppt.

Turn Over

Accept: Ammoniacal silver nitrate.

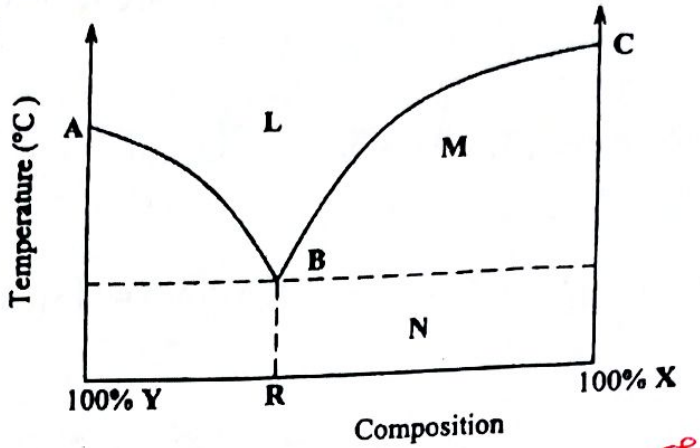
 CHO – No observable change

6

CH_3CHO – Silver mirror.

* – Spelling of reagents have should be correct
– No use of formulae
– rej: Both name and formulae but award for observation

4. The temperature – composition diagram for a system containing two components ***X*** and ***Y*** is shown below.



(a) State what the following represents;

(i) Regions: **L** Liquid mixture .... (½ mark)

reg: solution since its a phase diagram: emphasise phase

M Solid X and liquid .... (½ mark)

N Solid X and solid Y .... (½ mark)

(ii) Points: **A** Melting point/freezing point of pure Y (½ mark)

B Eutectic point .... (½ mark)

C Melting point/freezing point of pure X (½ mark)

(iii) Curves: **AB** Variation of freezing point of Y as X is added (½ mark)

BC Variation of freezing point of X as Y is added (½ mark)

Accept mpt

Accept lowering or decreasing of melting point

(b) State what would happen when a mixture of composition ***R*** is heated. (½ mark)

The solid mixture melts at B to a liquid mixture of the same composition.

Accept solidus ....

06

5. Write equation for the reaction between aqueous sodium hydroxide and

(a) chromium(III) oxide. (1½ marks)

$Cr_2O_{3(s)} + 6\bar{O}H_{(aq)} + 3H_2O_{(l)} \rightarrow 2Cr(OH)_{6(aq)}^{3-}$

$Cr_2O_{3(s)} + 2\bar{O}H_{(aq)} + 3H_2O \rightarrow 2Cr(OH)_{4(aq)}^{-}$

$Cr_2O_{3(s)} + 2\bar{O}H_{(aq)} \rightarrow 2CrO_{2(aq)}^{-} + H_2O$

(b) beryllium oxide. (1½ marks)

$BeO_{(s)} + 2\bar{O}H_{(aq)} + H_2O_{(l)} \rightarrow Be(OH)_4^{2-}$

$BeO_{(s)} + 2\bar{O}H_{(aq)} \rightarrow BeO_{2(aq)}^{2-} + H_2O_{(l)}$

(c) tin(II) oxide. (1½ marks)

$SnO_{(s)} + 2\bar{O}H_{(aq)} + H_2O_{(l)} \rightarrow Sn(OH)_{4(aq)}^{2-}$

- Accept alternative correct equations
- accept molecular equations
- reject unbalanced equations
- ½ for states.

04½

6. Complete the following equations and in each case, write a mechanism for the reaction. *(2½ marks)*

(a) $(CH_3)_2C=CHCH_3 \xrightarrow{HBr}$

Mechanism:

$(CH_3)_2C=CHCH_3 \longrightarrow (CH_3)_2\overset{+}{C}CH_2CH_3$

$H-Br$ ⟶ Br^-

$\downarrow$

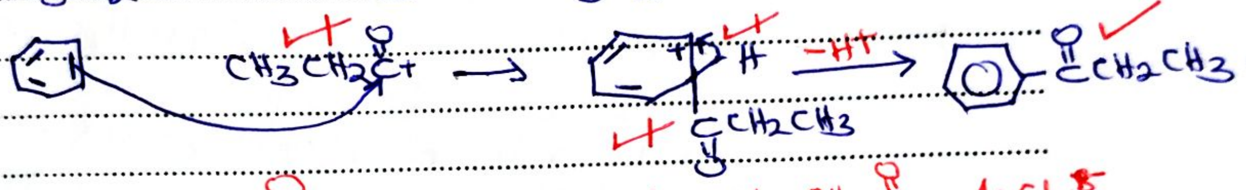
$(CH_3)_2\underset{Br}{C}CH_2CH_3$

- rej: Having arrow
- Having bond

(b)  $+ CH_3CH_2-\overset{O}{\overset{||}{C}}-Cl \xrightarrow[50^\circ C]{AlCl_3}$ *(2½ marks)*

Mechanism:

$CH_3CH_2\overset{O}{\overset{||}{C}}-Cl + AlCl_3 \longrightarrow CH_3CH_2\overset{O}{\overset{||}{C}}^+ + AlCl_4^-$



Accept $CH_3CH_2\overset{O}{\overset{||}{C}}-Cl + AlCl_3 \longrightarrow CH_3CH_2\overset{O}{\overset{||}{C}}^{\delta+}---AlCl_4^{\delta-}$

7. When a current of 0.65 A was passed through copper(II) sulphate solution using platinum electrodes for 35 minutes, 0.0143 g of hydrogen and 0.113 g of oxygen were evolved.

(a) Write equation for the reaction that took place at the

(i) anode. *(01 mark)*

$4OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e^-$

(ii) cathode. *(01 mark)*

$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$

Accept $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$

(b) Determine the quantity of electricity required to evolve 1 mole of gas at each electrode.

(ii) At the anode. *(02 marks)*

Quantity of electricity $= (0.65 \times 35 \times 60) = 1365C$

Moles of oxygen evolved $= \left(\frac{0.113}{32}\right) = 3.53 \times 10^{-3}$

3.53×10^{-3} moles of oxygen evolved by $1365C$

1 mole of oxygen is liberated by $\left(\frac{1365}{3.53 \times 10^{-3}}\right)$

Turn Over

$= 386685C$

(ii) At the cathode. *(01 mark)*

$2H^+_{(aq)} + 2e \longrightarrow H_{2(g)}$

Mole of hydrogen evolved $= \frac{0.0143}{2} = 7.15 \times 10^{-3}$ mole

7.15×10^{-3} moles hydrogen evolved by 1365C

1 mole of hydrogen evolved by $(1365 / 7.15 \times 10^{-3}) = 190909C$. 05

8. State what would be observed and write equation for the reaction that would take place when:

(a) excess concentrated hydrochloric acid was added to lead(II) oxide. *(2½ marks)*

Yellow solid dissolve forming a colorless solution.

$PbO_{(s)} + 4HCl_{(aq)} \longrightarrow H_2PbCl_{4(aq)} + H_2O_{(l)}$ 03

$PbO_{(s)} + 2H^+_{(aq)} + 4Cl^-_{(aq)} \longrightarrow PbCl_4^{2-}{}_{(aq)} + H_2O_{(l)}$

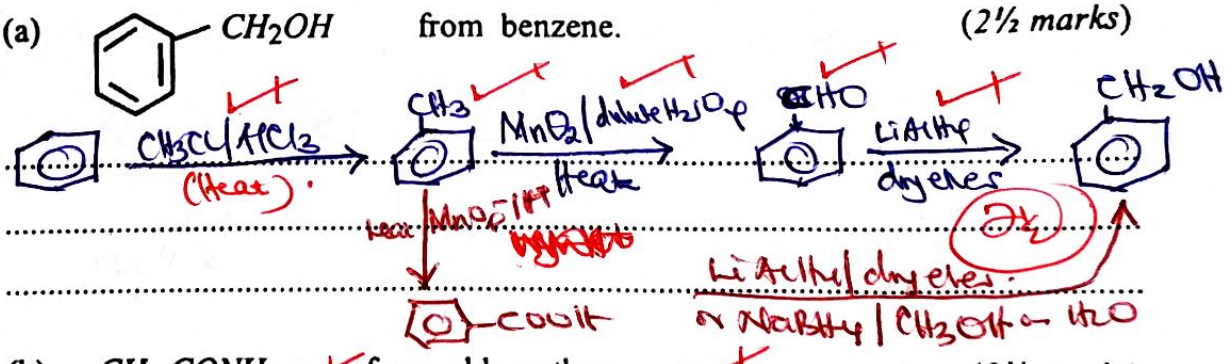
(b) potassium iodide was added to copper(II) sulphate solution. *(2½ marks)*

Blue solution turns to a brown solution and a white precipitate. $2Cu^{2+}_{(aq)} + 4I^-_{(aq)} \longrightarrow Cu_2I_{2(s)} + I_{2(aq)}$ 03

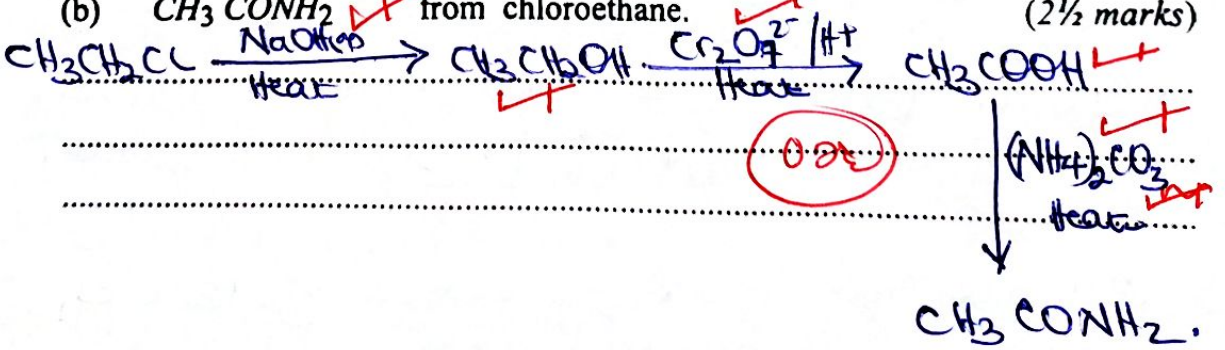
06

9. Write equation in each case to show how the following conversions can be effected:

(a) CH_2OH from benzene. *(2½ marks)*



(b) CH_3CONH_2 from chloroethane. *(2½ marks)*



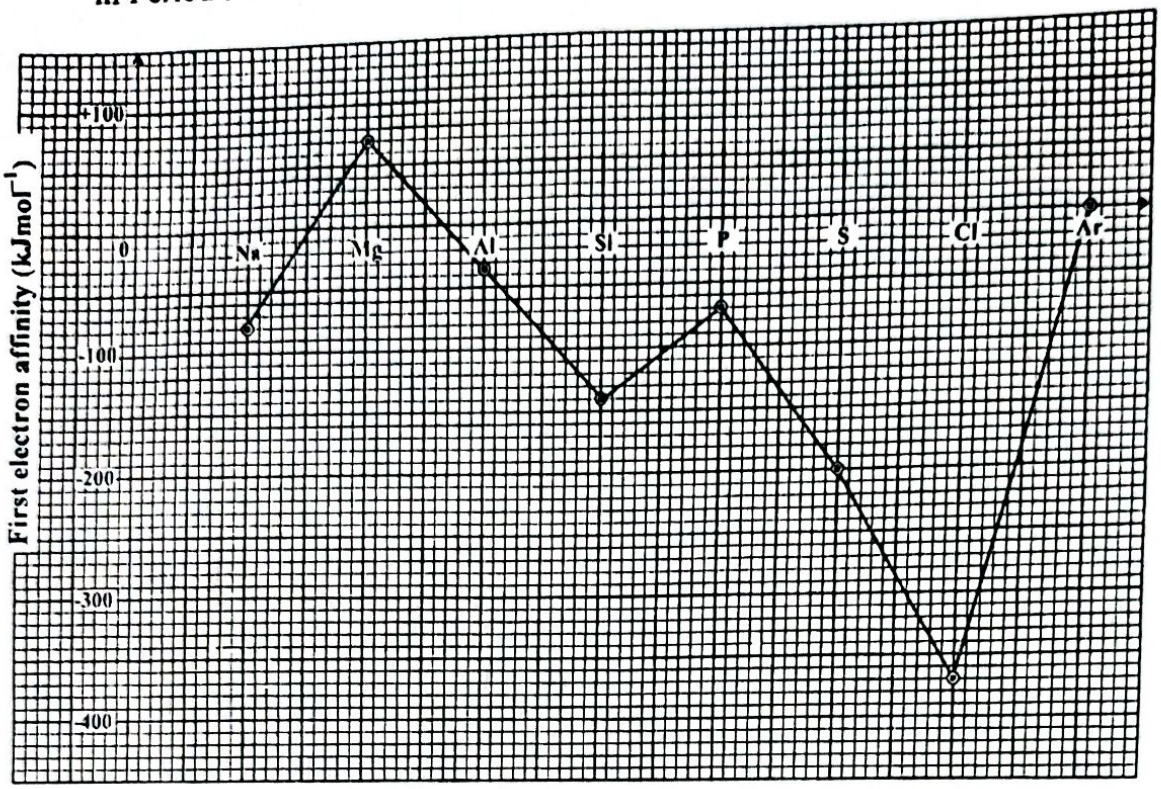
Accept alternative routes.

05

SECTION B: (54 MARKS)

Answer any **six** *questions from this section.*

10. The figure below shows the variation of the first electron affinity of the elements in Period 3 of the Periodic Table.



Explain each of the following observations:

(i) There is a general increase in the first electron affinity from sodium to argon. *(1½ marks)*

From sodium to argon atomic radius decrease, nuclear charge increase hence effective nuclear charge increases. As a result attraction force for incoming electron increase, thus electron affinity increase. (1½)

(ii) The first electron affinity of magnesium is higher than that of aluminium. *(04 marks)*

Mg $1s^2 2s^2 2p^6 3s^2$ Al $1s^2 2s^2 2p^6 3s^2 3p^1$

In magnesium the electron is added to an energy level that is completely filled 3S- sub energy level which is stable. The electron experiences greater repulsion from the existing electrons than nuclear attraction. (04)

In aluminium the 3p sub energy level has one electron and is unstable therefore the added electron experiences more attraction from the nucleus than repulsion.

eg: not fully or half filled

(iii) The first electron affinity of phosphorous is less than that of sulphur. *(3½ marks)*

P $1s^2 2s^2 2p^6 3s^2 3p^3$ S $1s^2 2s^2 2p^6 3s^2 3p^4$.

In phosphorus the electron is added to a half filled 3p- subshell which is energetically stable. The incoming electron experiences more repulsion than attraction from the nucleus hence a lower electron affinity. (03½)

In sulphur the electron is added to the 3p sub energy level with four electrons which is energetically unstable.

Therefore the incoming electron experiences more nuclear attraction than repulsion hence higher electron affinity. 09

11. (a) Silver chloride dissolves in water according to the following equation.

$$AgCl_{(s)} \rightleftharpoons Ag^{+}(aq) + Cl^{-}(aq).$$

Write the expression for the solubility product, *Ksp* of silver chloride. (*01 mark*)

$K_{sp} = [Ag^+][Cl^-]$ ✓ (1) strictly square brackets.

(b) The electrolytic conductivity of a saturated solution of silver chloride in water at 25°C is $3.41 \times 10^{-6}\ \Omega^{-1}\ cm^{-1}$ and that of pure water is $1.6 \times 10^{-6}\ \Omega^{-1} cm^{-1}$. Calculate the solubility product of a saturated solution of silver chloride at 25°C.

(*The molar conductivities at infinite dilution of silver nitrate, potassium nitrate and potassium chloride are 133.4, 145.0 and 149.9* $\Omega^{-1}cm^{2}\ mol^{-1}$ *respectively at 25°C*). (*4½ marks*)

$\Lambda_o AgCl = \Lambda_o AgNO_3 + \Lambda_o KCl - \Lambda_o KNO_3$ ½ deny if Λ used instead of Λ_o

$= 133.4 + 149.9 - 145.0 = 138.3\ \Omega^{-1} cm^2 mol^{-1}$ ½ ignore units

Electrolytic conductivity of AgCl = $K_{solution} - K_{water}$ ½

$= (3.41 \times 10^{-6} - 1.6 \times 10^{-6})$

Allow $C = \frac{K}{\Lambda}$

$= 1.81 \times 10^{-6}\ \Omega^{-1} cm^{-1}$ ½

rej: $S = \frac{K}{\Lambda}$

$[AgCl]$ or $C = \frac{1000K}{\Lambda}$ ½ $= \frac{1.81 \times 10^{-6} \times 1000}{138.3}$ ½

$= 1.31 \times 10^{-5}\ mol\ dm^{-3}$ ½ (04½)

$K_{sp} = (1.31 \times 10^{-5})^2$ ½ $= 1.72 \times 10^{-10}\ mol^2 dm^{-6}$. ½ Ignore units

(c) Ammonia solution was added to a solution containing silver chloride.

(i) State how the solubility of silver chloride was affected. (*01 mark*)

If c(i) is wrong deny mark explanation.

Solubility increases. ✓ (1)

(ii) Explain your answer in (c)(i) above. (*2½ marks*)

Ammonia reacts with silver ions ½ to form a complex ion ½ which lowers the concentration of silver ions. ½ More silver chloride dissolves ½ in order to restore the equilibrium and to maintain the value of the equilibrium constant. ½ (02½)

rej: dissociates for dissolves.

09

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12. Compound T, C_3H_6O reacts with 2, 4- dinitrophenylhydrazine to form a yellow precipitate.

(a) Write the names and the structural formulae of all possible isomers of T. *(03 marks)*

$CH_3\overset{O}{\overset{\|}{C}}CH_3$ Propanone ✓ $CH_3CH_2\overset{O}{\overset{\|}{C}}H$ Propanal ✓ (03)

extra wrong one cancels out the correct one.

(b) T reacts with ammoniacal silver nitrate solution to form silver. *(01 mark)*
Identify T.

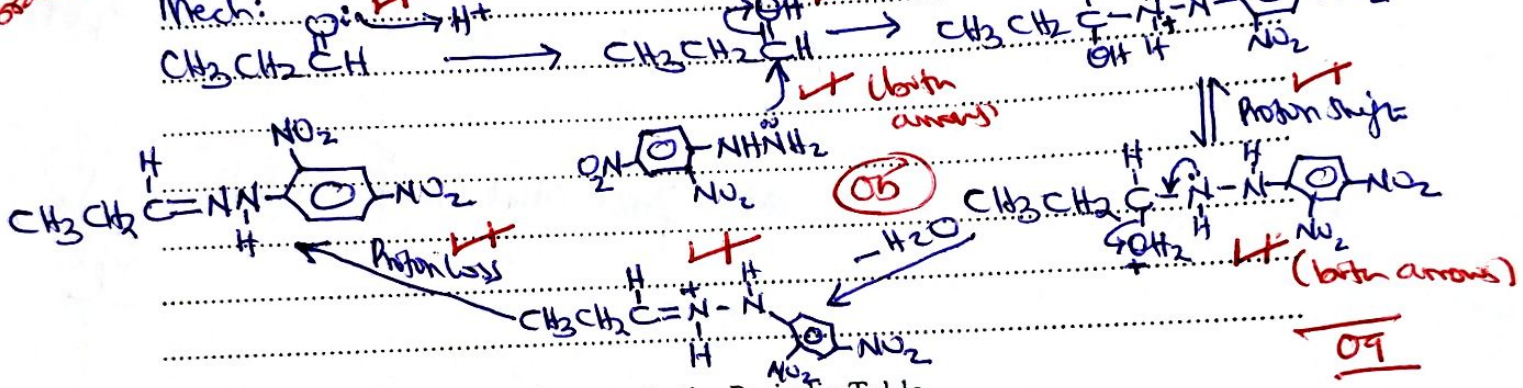
$CH_3CH_2\overset{O}{\overset{\|}{C}}H$ ✓ or Propanal. (1)

(c) Write equation and indicate a mechanism for the reaction between T and 2, 4- dinitrophenylhydrazine under acidic condition. *(05 marks)*

- structure of Reagent ✓

$CH_3CH_2\overset{O}{\overset{\|}{C}}H + O_2N(C_6H_3)(NO_2)NHNH_2 \xrightarrow{H^+} CH_3CH_2C{=}N{-}NH(C_6H_3)(NO_2)_2$ ✓

Mech:



09

13. Manganese is a *d*–block element in the Periodic Table.

(a) Define the term ***d*–block element**. *(01 mark)*

It an elements in which the outermost electrons fill the d sub energy level. ✓ (1) rej 3d or 4d;

(b) (i) Write the electronic configuration of manganese. *(½ mark)*

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$ ✓ accept ---$4s^2 3d^5$ rej: $[Ar]4s^2 3d^5$

(ii) State the common oxidation states exhibited by manganese in its compounds. *(1½ marks)*

+2 ✓ +4 ✓ and +7 ✓ deduct ½ for extra wrong one eg +3; +6

rej: 2 or T2 (charge).

(iii) Write the formulae of oxides of manganese in each of the oxidation states you have stated in (b)(ii). *(1½ marks)*

MnO ✓; MnO_2 ✓ and Mn_2O_7 ✓ (1½)

(c) A black oxide, Y of manganese was fused with a mixture of potassium hydroxide and potassium nitrate to give a compound which when treated with water gave a green solution.

The green solution turned purple when acidified with sulphuric acid.
Identify:

(i) Y Manganese (IV) oxide | Manganese dioxide | MnO_2. (01 mark)

(ii) the ion that gives the green solution its colour. (01 mark)
MnO_4^{2-} or Manganate (VI) ion.

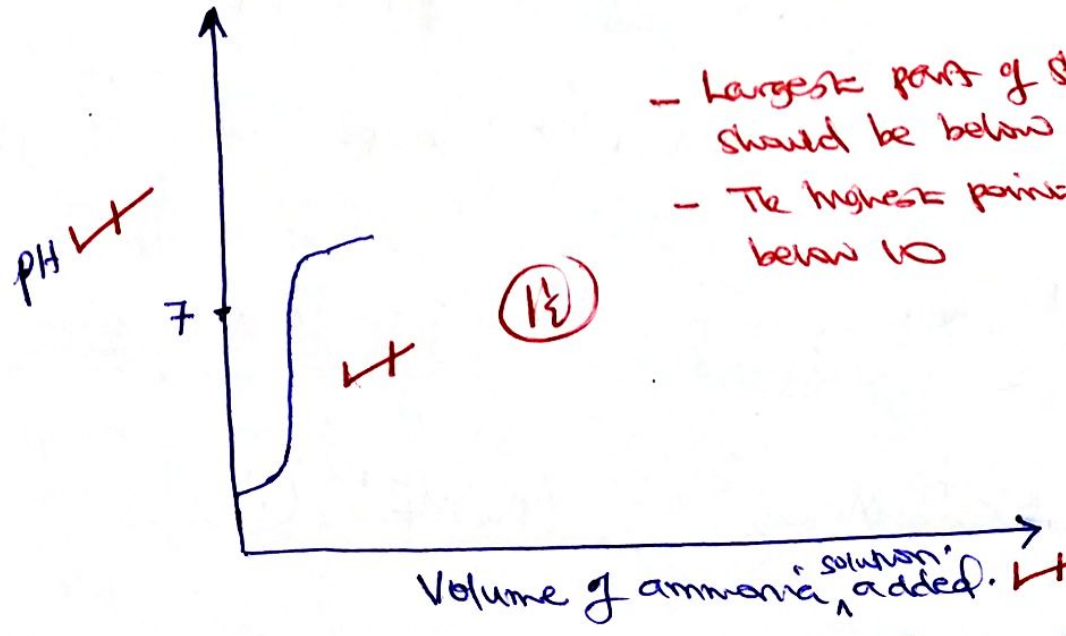
(iii) the ion that gives the purple solution its colour. (01 mark)
Manganate (VII) ion or permanganate ion or MnO_4^-(aq)

(d) Write ionic equation for the reaction leading to the formation of the purple solution. (1½ marks)

$3MnO_4^{2-}(aq) + 4H^+(aq) \longrightarrow 2MnO_4^-(aq) + MnO_{2(s)} + 2H_2O_{(l)}$

0½

14. (a) (i) Sketch a graph to show the pH change when hydrochloric acid is titrated with ammonia solution. (1½ marks)



(1½)

- Largest part of steep part should be below 7
- The highest point should be below 10

emphasise solution in reg: Volume of ammonia

(ii) Explain the shape of your sketch graph in (a)(i). (3½ marks)

- Initially the pH is low because the concentration of hydrogen ions is high from acid
- pH gradually rises as ammonia solution is added because hydrogen ions are being neutralised. This is followed by a sharp rise in pH with little ammonia solution added signifying end point. end point has been reached
- The pH of the solution at end point is less than 7 because the salt formed is hydrolysed by water forming hydrogen ions. (03½)
- After end point there is a gradual rise in pH due to excess ammonia solution added which together with the salt forms a buffer solution.

(b) Calculate the pH of a resultant solution formed when 10 cm^3 of a 0.1M sodium hydroxide solution is added to 25 cm^3 of a 0.1M ethanoic acid at 25 °C.

(*Dissociation constant of ethanoic acid at 25 °C = 1.8×10^{-5} mol dm^{-3}*). (04 marks)

No of moles of NaOH used = $\left(\frac{0.1 \times 10}{1000}\right) = 1.0 \times 10^{-3}$

No of moles of CH_3COOH used = $\left(\frac{0.1 \times 25}{1000}\right) = 2.5 \times 10^{-3}$ (04)

$CH_3COOH_{(aq)} + NaOH_{(aq)} \longrightarrow CH_3COONa_{(aq)} + H_2O_{(l)}$

No of moles of salt formed = 1.0×10^{-3}

Excess moles of acid $[CH_3COO] = (2.5 \times 10^{-3} - 1.0 \times 10^{-3}) = 1.5 \times 10^{-3}$ moles.

$[CH_3COOH] = \left(\frac{1.5 \times 10^{-3} \times 1000}{35}\right) = 0.04286M$

$[CH_3COONa] = \left(\frac{1.0 \times 10^{-3} \times 1000 \times 1000}{35}\right) = 0.0286M$

0.0286 Accept

$pH = pKa + \log \frac{[SALT]}{[ACID]}$

$[H^+] = \frac{Ka\,[ACID]}{[SALT]}$.

$pH = -\log 1.85 \times 10^{-5} + \log \left(\frac{0.0286}{0.04286}\right)$

$= 4.57$. 09

15. (a) Beryllium, magnesium, calcium and barium are some of the elements that belong to Group II of the Periodic Table.

State how the elements react with sulphuric acid and give the conditions for the reactions. (03 marks)

- Beryllium reacts with warm dilute H_2SO_4 forms beryllium sulphate and hydrogen gas
- Magnesium reacts with cold dilute H_2SO_4 forms magnesium sulphate and hydrogen gas
- Calcium and barium react slowly with cold dilute H_2SO_4 and reaction stops due to the formation of insoluble sulphates (03)
- Beryllium reacts with concentrated sulphuric acid to form beryllium sulphate, sulphur dioxide and water.
- Magnesium reacts with hot concentrated H_2SO_4 to form $MgSO_4$, H_2O and SO_2
- Calcium and barium react with hot concentrated H_2SO_4 to form insoluble sulphates which stop the reaction.

(b) (i) State how the solubilities of the sulphates of Group II elements vary down the group. *(01 mark)*

The solubility decreases down the group. ✓ (1)

(ii) Explain your answer in (b)(i). *(02 marks)*

- Both lattice and hydration energy decrease from magnesium ion to barium ion due to the increase in cationic radius, however hydration energy decreases more rapidly than lattice energy leading to a decrease in solubility. ✓ ✓ (02)

(c) Write equation for the reaction of:

(i) beryllium with sodium hydroxide solution. *(1½ marks)*

$Be_{(s)} + 2\bar{O}H_{(aq)} + 2H_2O_{(l)} \longrightarrow Be(OH)_4^{2-}{}_{(aq)} + H_{2(g)}$ ✓ ✓ (1½)

(ii) calcium carbide with water. *(1½ marks)*

$CaC_{2(s)} + 2H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)} + C_2H_{2(g)}$ ✓ ✓ (1½)

05

16. In the manufacture of ammonia, nitrogen is catalytically hydrogenated to give ammonia according to the following equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = 92.5 \text{ kJ}$$

(a) (i) Name the catalyst used in the reaction. *(½ mark)*

Iron ✓ (½) reject both symbol and name or symbol.

(ii) Write the expression for the equilibrium constant, K_p for the reaction. *(01 mark)*

$K_p = \dfrac{(P_{NH_3})^2}{(P_{N_2})(P_{H_2})^3}$ ✓ (1)

(b) State what would happen to the position of the equilibrium if:

(i) pressure was increased. *(01 mark)*

Equilibrium position would shift to the right. ✓ (1)

(ii) temperature was increased. *(01 mark)*

Equilibrium position would shift to the right. ✓ (1)

(c) When 3 moles of hydrogen and 1 mole of nitrogen were mixed and allowed to attain equilibrium at 100 atms and 400°C, the equilibrium mixture contained 25% of ammonia by volume.

Let X be moles of N_2 that reacted at eq.

Calculate the:

(i) number of moles of nitrogen and hydrogen at equilibrium. *(03 marks)*

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

	N_2	H_2	NH_3
Initially	1	3	0
Moles at eq=m	(1-x)	3-3x	2x

Total moles at eq=m = (1-x+3-3x+2x)

= 4-2x

$\%N_2 = \frac{2x}{4-x} = \frac{25}{100}$, $x = 0.4$ moles

Equilibrium moles $N_2 = (1-0.4) = 0.6$ moles

$H_2 = 3(1-0.4) = 1.8$ moles

(ii) value of the equilibrium constant, K_p at 400°C. *(2½ marks)*

Total moles = (4-2x) = 4-0.8 = 3.2.

$P_{N_2} = \left(\frac{0.6}{3.2} \times 100\right) = 18.75$ Atm.

$P_{H_2} = \left(\frac{1.8}{3.2} \times 100\right) = 56.25$ Atm

$P_{NH_3} = \left(\frac{0.8}{3.2} \times 100\right) = 25$ Atm.

$K_p = \frac{(25)^2}{(18.75)(56.25)^2}$

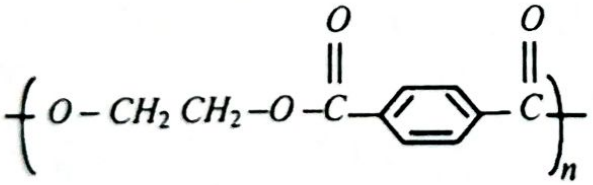
$= 1.87 \times 10^{-4}$ Atm^{-2}.

17. (a) Differentiate between **addition** and **condensation** polymers. *(02 marks)*

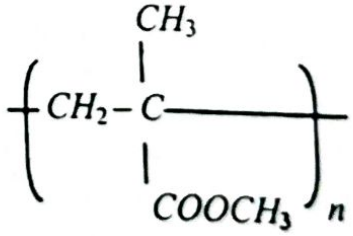
Addition polymers are formed when very many molecules of one unsaturated combine without loss of small molecules while condensation polymers are formed when two different bifunctional monomers combine with loss of small molecules eg water.

(b) The structural formulae of two polymers **R** and **T** are shown below.

R



T



Name the polymer:

(i) **R** ..... Terylene ..... accept Dacron *(01 mark)*

(ii) **T** ..... Perspex ..... or Polymethyl-2-methylpropenoate. *(01 mark)*

(c) **Write the structural formula(e) of monomer(s) of the polymers R and T respectively.** *(03 marks)*

R $HOCH_2CH_2OH$ ✓ and HO_2C–C$_6$H$_4$–CO_2H

T $H_2C=C(CH_3)-C(=O)-OCH_3$ ✓ (02) H_3COOC–C$_6$H$_4$–$COOCH_3$

for Dacron.

(d) **Give one use of :**

(i) **R** Making clothes (Fabrics) ✓ *(01 mark)*

(ii) **T** Making lenses, rulers, ✓ *(01 mark)*
Corrugated roof lights,
aeroplane windows.

eg. making glass or glass windows.

09

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 TI 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.