P525/1
Chemistry
Paper 1
July - August 2022
2¾ hours

MARKING GUIDE

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS - 2022

NAME.....

INDEX NO.....SIGNATURE.....

UGANDA ADVANCED CERTIFICATE OF EDUCATION
Chemistry
Paper 1
2 hour 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 will be provided.*
- *Molar volume of a gas at s.t.p is 22.4 litres*
- *Standard temperature = 273K*
- *Illustrate your answers with equations where applicable*
- *Molar gas constant $R=8.314\ Jmol^{-1}K^{-1}$.*
- *1 atmosphere $=101325Nm^{-2}$.*

For Examiners Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	TOTAL

1. (a) Balance the following nuclear equations and in each case identify **M**.

(i) $^{7}_{3}Li + {}^{1}_{1}H \longrightarrow 2M$. $^{4}_{2}He$ ✓ *(01 mark)* 1

(ii) $^{214}_{84}Po + {}^{1}_{0}n \longrightarrow {}^{86}_{34}Se + {}^{150}_{60}Nd + M$ Topographic error *(01 mark)*

(b) A radioactive nucleus had an initial activity of 12.4 counts per minutes, which reduced by 75% after 13.5 minutes. Determine the half life of the nucleus. *(03 marks)*

Activity after 13.5 minutes $= \left(\frac{12.4 \times 25}{100}\right) = 3.1$ counts min^{-1} ✓

$\ln\left(\frac{N_t}{N_0}\right) = -\lambda t$ ✓

$\ln\left(\frac{3.1}{12.4}\right) = -13.5\lambda$ ✓

$\lambda = 0.1026885$ ✓

$t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$ ✓

$t_{\frac{1}{2}} = \frac{\ln 2}{0.1026885} = 6.749998 \simeq 6.8$ minutes ✓ ✓ ✓ 4½

OR Mass present $= (100 - 75) = 25$ ✓

Using $\frac{N_t}{N_0} = -\lambda t$ ✓, $\frac{25}{100} = -13.5\lambda$ ✓

$\lambda = 0.1026885$ ✓

$t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$

$t_{\frac{1}{2}} = \frac{\ln 2}{0.1026885} = 6.749998$ ✓

$\simeq 6.8$ minutes ✓ 3½

Allow any other correct alternative

2. Write equations for the reactions that take place when the following substances are reacted with aqueous sodium hydroxide.

(a) Aluminium oxide. *(1½ marks)*

Acc: $Al_2O_3(s) + 6\bar{O}H(aq) + 3H_2O(l) \longrightarrow 2Al(OH)_6^{3-}(aq)$

$Al_2O_3(s) + 2\bar{O}H(aq) + 3H_2O(l) \longrightarrow 2Al(OH)_4^{-}(aq)$ ✓✓ 1½

OR $Al_2O_3(s) + 2\bar{O}H(aq) \longrightarrow 2AlO_2^{-}(aq) + H_2O(l)$

(b) Beryllium oxide. *(1½ marks)*

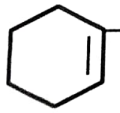
$BeO(s) + 2\bar{O}H(aq) + H_2O(l) \longrightarrow Be(OH)_4^{2-}(aq)$ ✓✓ 1½

OR $BeO(s) + 2\bar{O}H(aq) \longrightarrow BeO_2^{2-}(aq) + H_2O(l)$

(c) Chromium (VI) oxide. *(1½ marks)*

$CrO_3(s) + 2\bar{O}H(aq) \longrightarrow CrO_4^{2-}(aq) + H_2O(l)$ ✓✓ 1½ 4½

3. State giving equations, what would be observed when the following pairs of compounds are mixed

(a)  and alkaline potassium manganate (VII) solution.

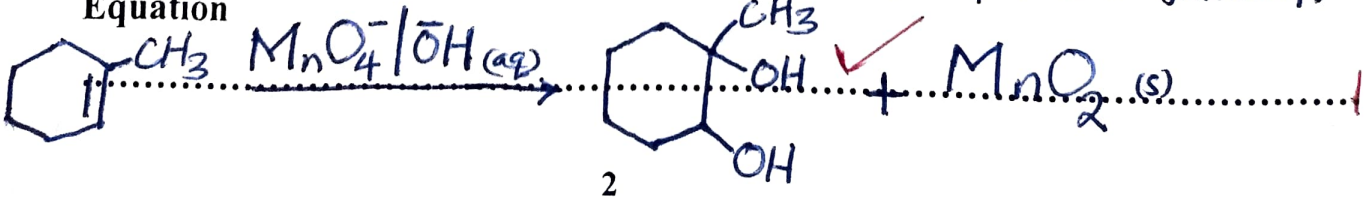
(02 marks)

Observation

Purple solution turns dark green ✓ and a brown precipitate is formed ✓

OR Purple solution turns colourless and brown precipitate is formed. 1

Equation



1

(b) $CH_3C \equiv CH$ and ammoniacal silver nitrate solution. *(02 marks)*

Observation

White precipitate. ✓

Equation

$CH_3C{\equiv}CH \xrightarrow{NH_3(aq)/AgNO_3(aq)} CH_2C{\equiv}CAg(s) + NH_4NO_3(aq)$

OR $CH_3C{\equiv}CH + Ag(NH_3)_2^+(aq) \longrightarrow CH_3C{\equiv}CAg(s) + NH_4^+(aq) + NH_3(aq)$

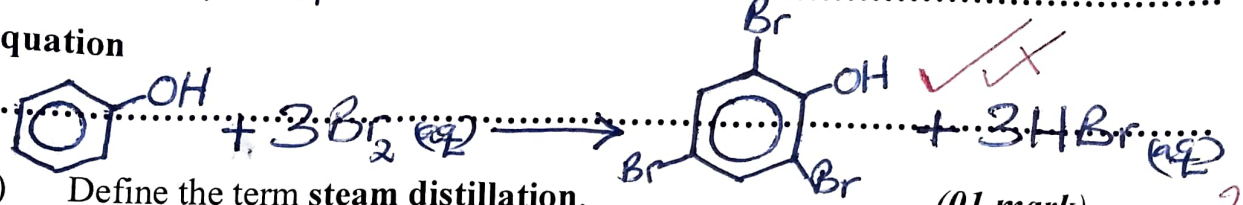
OR $CH_3C{\equiv}CH + Ag(NH_3)_2NO_3(aq) \longrightarrow CH_3C{\equiv}CAg(s) + NH_4NO_3(aq) + NH_3(aq)$

(c) Phenol and bromine water. *(02 marks)*

Observation

White precipitate ✓

Equation



$+ 3Br_2(aq) \longrightarrow$ $+ 3HBr(aq)$

6

4. (a) (i) Define the term **steam distillation**. *(01 mark)*

This is a technique of separating a volatile liquid which is immiscible with water from non-volatile impurities at a temperature below its boiling point by passing steam through the heated mixture. ✓

(ii) Mention **two** requirements for a component to be separated by steam distillation. ~~*(02 marks)*~~ 1 mark

It should be immiscible with water ✓

It should have a high relative molecular mass. ✓

It should be more volatile than impurities.

(b) (i) A mixture containing a substance **Q** was steam distilled at 760mmHg at 96^{0}C. The distilled contained 15% by mass of **Q**. If the vapour pressure of water is 734mmHg at 96^{0}C, calculate the molar mass of **Q**. *(03 marks)*

Mass of water $= (100-15) = 85$g ✓

$VP_Q = (760-734) = 26$mmHg ✓

Using $\frac{Mr_Q \times M_{water}}{Mass_Q \times M_{r\,water}} = \frac{VP_{water}}{VP_Q}$

$\frac{Mr_Q \times 85}{15 \times 18} = \frac{734}{26}$ ✓

$Mr_Q = 89.67 \simeq 90$ g ✓

5½

(ii) State **one** advantage of using steam distillation in purification of substances.

(½ mark)

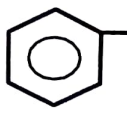
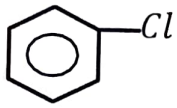
- Used in purification of organic compounds that decompose near or at their boiling points. ½
- Enable distillations at low temperature which reduces on deterioration of the desired compound.

5. State how the following organic substances can be synthesized
(no equations are required)

Acc:- Concentrated phosphoric acid at 200°C for concentrated sulphuric acid 180°C.
- Bromine in presence of water for bromine water.
- Aluminium oxide at 350°C for conc. H_2SO_4 at 180°C.

(a) $CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2Br$ *from* $CH_3\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}CH_3$ *(2½ marks)*

$(CH_3)_3C-OH$ is dehydrated using concentrated sulphuric acid at 180°C to form $(CH_3)_2C=CH_2$ (2-methylpropene) which is then reacted with bromine water to form $(CH_3)_2\overset{\overset{OH}{|}}{C}-CH_2Br$ (1-bromo-2-methylpropan-2-ol) 2½

(b)  from  *(03 marks)*

 is heated with sodium hydroxide at 350°C and high pressure (15 atm) to form sodium phenoxide which is then reacted with chloro/bromo/iodomethane to form 

OR  is reacted with steam at 425°C in presence of silicon or Nickel catalyst to form phenol that is then reacted with chloro/bromo/iodomethane in presence of alkali (aqueous sodium hydroxide) to form  3

5½

(a) State what is meant by the term **first electron affinity**. ***(01 mark)***

The enthalpy change that occurs when one mole of electrons is added to one mole of gaseous atoms to form one mole of unigatively charge gaseous ions. ✓ 1

(b) The table below shows the first electron affinities of halogens.

Halogen	First electron affinity ($kJmol^{-1}$)
Fluorine	−328
Chlorine	−349
Bromine	−325
Iodine	−295

(i) State the trend of electron affinities among the halogens down the group. ***(01 mark)***

Acc: Electron affinities generally decrease down the group.

First electron affinities decrease down the group but the electron affinity of fluorine is less than expected ✓ 1

(ii) Explain the observed trend in (i) above. ***(03 marks)***

Down the group nuclear charge is outweighed by screening effect, atomic radius increases so nuclear attraction for the incoming electron reduces; less energy is therefore lost as electron is added to an atom. Fluorine atom has a very small atomic radius and so its electrons are so crowded together that exhibit great repulsion between themselves and so do not take up the incoming electron with ease. 3

5

7. $25cm^3$ of a gaseous hydrocarbon **W** was exploded with $200cm^3$ of oxygen. On cooling to room temperature, the residual gases occupied $150cm^3$. After shaking with concentrated potassium hydroxide solution, the final volume was $50cm^3$.

2½ marks

(a) Determine the molecular formula of **W**. ***(03 marks)***

Volume of CO_2 formed $= (150-50) = 100\,cm^3$ ✓+

Volume of O_2 reacted $= (200-50) = 150\,cm^3$ ✓+

$C_xH_y + (x+y/4)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

25	$25(x+y/4)$	$25x$
$25x = 100$	$25(x+y/4) = 150$	∴ M.F is C_4H_8 ✓+
$x = 4$ ✓+	$4 + y/4 = 6$	
	$y = 8$ ✓+	

2½

(b) Write the structural formulae of all the possible isomers of **W** and name them. ***(02 marks)***

$CH_3CH=CHCH_3$; But-2-ene ✓+

$CH_2CH_2CH=CH_2$; But-1-ene ✓+

$CH_2C=CH_2$; 2-methylpropene ✓+
$\quad\;\; CH_3$

Cyclobutane ✓+

4½ 2

8. (a) (i) Define the term **bond energy**. ***(01 mark)***

The amount of heat energy released when one mole of covalent bonds is formed from it free gaseous atoms ✓ OR

The heat absorbed when one mole of covalent bonds is broken to formed free gaseous atoms. 1

(ii) State how any **one** factor affects bond energy. ***(01 mark)***

- Bond length ✓ The shorter the bond, the stronger it is and hence the higher the bond energy. However, the longer the bond the weaker it is and hence the lower the bond energy. ✓+
- Number of shared electrons (or Number of bonding electron pairs
- Atomic radius
- Bond length.
- Difference in electronegativity between the bonding atoms. 1

(b) The enthalpy of formation of phosphorus (V) chloride is $664.35 kJmol^{-1}$ and theenthalpies of atomization of phosphorus and chlorine are $+314$ and $+242\ kJmol^{-1}$ respectively.
Calculate the average bond energy of phosphorus – chlorine ($P - Cl$) bond.
(03 marks)

$\frac{1}{4}P_4(s) + \frac{5}{2}Cl_2(g) \xrightarrow{-664.35} PCl_5(s)$

$+314$ ✓ ; $(5X+242)$ ✓ ; $-5[P-Cl]$ ✓

$P(g) + 5Cl(g)$

$314 + (5X242) - 5[P-Cl] = -664.35$ ✓

$-5[P-Cl] = -2188.35$ ✓

$\therefore P-Cl = +437.67\ kJmol^{-1}$ ✓

ACC:

$\frac{1}{4}P_4(s) + \frac{5}{2}Cl_2(g) \xrightarrow{-664.35} PCl_5(s)$

$+314$ ✓ ; $(5X+242)$ ✓ ; $5BE$ ✓

$P(g) + 5Cl(g)$

$314 + (5X+242) + 5BE = -664.35$ ✓

$5BE = -2188.35$ ✓

$\therefore BE = -437.67\ kJmol^{-1}$ ✓ 3

5

9. (a) State what the term, **depression of freezing point constant** means.
(01 mark)

Is the depression in freezing point that occurs when one mole of non-volatile solute is dissolved in 1000g or 1kg of solvent. ✓ 1

(b) (i) A solution containing $x\ g$ of compound **Y**(RFM 74) in $20g$ of benzene had a depression in freezing point of 4.15^0C.
Determine the value of x.
(3½ marks)

20g of benzene dissolved x g of Y

1000g of benzene dissolved $\left(\frac{1000x}{20}\right)$ g of Y ✓

4.15°C is a depression caused by $\left(\frac{1000x}{20}\right)$ g of Y ✓

K_f is a depression caused by $\left(\frac{1000x \times K_f}{20 \times 4.15}\right)$ g ✓

$\Rightarrow \frac{1000x \times K_f}{20 \times 4.15} = 74$ ✓ $\therefore x = \left(\frac{6.142}{K_f}\right)$ g ✓

ACC:

1 mole of Y in 1000g of benzene has dep. K_f

74g of Y in 1000g of benzene has dep. K_f

x g of Y in 1000g of benzene has dep. $\left(\frac{K_f \times x}{74}\right)$ ✓

x g of Y in 20g of benzene has dep. $\left(\frac{K_f \times x \times 1000}{74 \times 20}\right)$ ✓

$\Rightarrow \frac{50x \times K_f}{74} = 4.15$ ✓

$\therefore x = \left(\frac{6.142}{K_f}\right)$ g ✓ 3

(ii) How would the value of relative formula mass be affected if the solute, **Y** dissociated in benzene?
(1½ marks)

Relative formula mass would reduce ✓. Dissociation increases moles (or number ~~of~~) of solute particles which is proportional to colligative property but colligative property is inversely proportional ✓ to molecular mass which therefore reduces.

5½

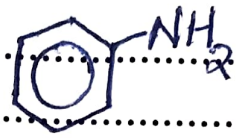
SECTION B

Answer six questions

10. Both aminobenzene and *N, N* –dimethylaminobenzene react with an ice cold mixture of aqueous sodium nitrite and concentrated hydrochloric acid to give colourless solution.

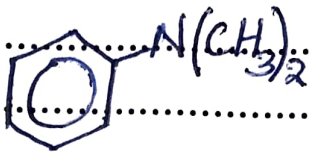
(a) Give the structural formula of;

(i) amino benzene. ***(01 mark)***



1

(ii) *N, N* –dimethylaminobenzene ***(01 mark)***



1

(b) (i) Name **one** reagent that can be used to distinguish between the two amino compounds using the colourless solutions formed. ***(01 mark)***

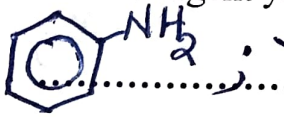
Alkaline phenol

Acc: 2-naphthol

1

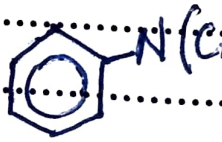
(ii) State what would be observed if the solutions are separately treated with the reagent you have name in (b) (i). ***(02 marks)***

With 2-naphthol


; Yellow precipitate/dye

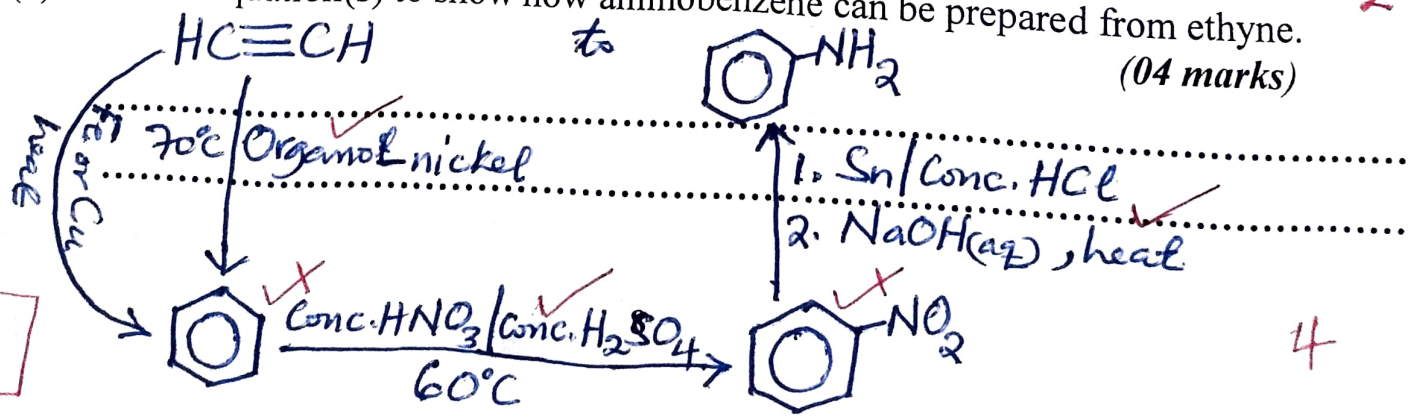

; No observable change


; Red precipitate/dye


; No observable change.

2

(c) Write equation(s) to show how aminobenzene can be prepared from ethyne. ***(04 marks)***



4

9

(a) When red lead, Pb_3O_4 was reacted with nitric acid a solid was formed.
Write equation for the reaction that took place. *(1½ marks)*

$Pb_3O_{4(s)} + 4HNO_{3(aq)} \longrightarrow PbO_{2(s)} + 2Pb(NO_3)_{2(aq)} + 2H_2O_{(l)}$ 1½

(b) The mixture from (a) was filtered and the residue dissolved in an acidified solution of manganese (II) sulphate.

Explain what was observed and write equations for the reaction. *(03 marks)*

Reddish-brown for black.

The black residue dissolved to form a purple solution.

Acc: The colourless solution turned purple. The manganese (II) ions were oxidized by lead (IV) oxide to manganate (VII).

$5PbO_{2(s)} + 2Mn^{2+}_{(aq)} + 4H^{+}_{(aq)} \longrightarrow 5Pb^{2+}_{(aq)} + 2MnO_4^-{}_{(aq)} + 2H_2O_{(l)}$ 3

(c) The filtrate from (a) was divided into two parts;

(i) To the first portion was added aqueous potassium chromate. State what was observed and write the equation for the reaction. *(1½ marks)*

A yellow precipitate

$Pb^{2+}_{(aq)} + CrO_4^{2-}{}_{(aq)} \longrightarrow PbCrO_{4(s)}$ 1½

(ii) The second part was evaporated to dryness and heated very strongly and allowed to cool.
State what was observed. *(1½ marks)*

A brown gas/fumes and a reddish-brown residue that turned yellow on cooling.

Write equation for the reaction that took place when the formed residue was dissolved in hot sodium hydroxide solution. *(1½ marks)*

$PbO_{(s)} + 2OH^-_{(aq)} + H_2O_{(l)} \longrightarrow Pb(OH)_4^{2-}{}_{(aq)}$

OR $PbO_{(s)} + 2OH^-_{(aq)} \longrightarrow PbO_2^{2-}{}_{(aq)} + H_2O_{(l)}$

OR $PbO_{(s)} + 4OH^-_{(aq)} + H_2O_{(l)} \longrightarrow Pb(OH)_6^{4-}{}_{(aq)}$

9

12. The following half cell reactions are given; (V)

$I_{2(aq)} + 2e \rightarrow 2I^-_{aq}$ +0.34

$PbO_{2(s)} + 4H^+_{(aq)} + 2e \rightarrow Pb^{2+}_{(aq)} + 2H_2O_{(l)}$ +1.46

(a) (i) Write the notation for the cell formed by combining the two half cells. *(02 marks)*

$Pt(s)|I^-_{(aq)}, I_{2(aq)}||PbO_{2(s)}|H^+_{(aq)}, Pb^{2+}_{(aq)}|Pt(s)$ ✓✓

OR $Pt(s)|I^-_{(aq)}, I_{2(aq)}||PbO_{2(s)}|H^+_{(aq)}, Pb^{2+}_{(aq)}, H_2O_{(l)}|Pt(s)$ 2

(ii) State what will be observed at the; *(01 mark)*

Anode

Colourless solution turns brown ✓ 1

(01 mark)

Cathode

Reddish brown solid dissolves to form a colourless solution. ✓ 1

(b) (i) Calculate the *emf* for the cell. *(1½ marks)*

$E_{cell} = E_R - E_L$ ✓

$= +1.46 - +0.34$ ✓

$= +1.12V$ ✓ ½

(ii) State whether the reaction is feasible or not. Give a reason for your answer. *(1½ marks)*

The reaction is feasible ✓ because emf of the cell is positive. ✓ 1½

(c) State **three** factors that influence the magnitude of standard electrode potential. *(1½ marks)*

Sublimation energy ✓ / Atomization energy

Ionization energy ✓ / Electron Affinity

Hydration energy ✓ 1½

(d) State **one** application of standard electrode potential. *(½ mark)*

- Determination of the feasibility of a reaction. ✓ ½
- Determination of equilibrium constant.
- Calculation of the emf of the cell.
- Determination of the solubility product of sparingly soluble salt.

9

(a) (i) Ammonia undergoes the following reaction in water

$NH_3(aq) + H_2O_{(l)} \rightleftharpoons NH_4^+(aq) + \bar{O}H(aq)$

Write the expression for the ionization constant, Kb for the reaction. ***(01 mark)***

$K_b = \frac{[NH_4^+][\bar{O}H]}{[NH_3]}$ ✓ 1

(b) (ii) water ionizes according to the equation

$H_2(l) + H_2O(l) \rightleftharpoons H_3O^+(aq) + \bar{O}H(aq)$

(i) Write the expression for the ionization constant, Kw for water. ***(01 mark)***

$K_w = [H_3O^+][\bar{O}H]$ ✓ 1

(iii) The hydrolysis of ammonium chloride is given by the equation

$NH_4^+(aq) + H_2O(l) \rightleftharpoons NH_3(aq) + H_3O^+(aq)$

Deduce the hydrolysis constant, Kh for ammonium chloride in terms of Kw and Kb. ***(03 marks)***

Accept any correct alternative working.

$K_h = \frac{[NH_3][H_3O^+]}{[NH_4^+]}$ ✓✓

$K_h = \frac{[NH_3][H_3O^+]}{[NH_4^+]} \times \frac{[\bar{O}H]}{[\bar{O}H]}$ ✓

But $k_w = [H_3O^+][\bar{O}H]$ ✓

$K_h = \frac{[NH_3]}{[NH_4^+][\bar{O}H]} \cdot k_w$ ✓

$K_h = \frac{1}{K_b} \times k_w$

$k_h = \frac{k_w}{K_b}$ ✓ 3

(b) Calculate;

(i) the hydrolysis constant, Kh, for ammonium chloride. ***(01 mark)***

$K_h = \frac{k_w}{k_b}$ | $K_h = \frac{1 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.5 \times 10^{-10}\ moldm^{-3}$

(ii) the hydrogen ion concentration. ~~***(02 marks)***~~ 1 mark

$K_h = \frac{[H_3O^+]^2}{[NH_4^+]}$ ✓

$[H_3O^+] = \sqrt{K_h[NH_4^+]}$ ✓ 1

(iii) hence the pH of a 0.01M ammonium chloride solution at 25^0C
($Kw = 1 \times 10^{-14} mol^2dm^{-6}$, $kb = 1.8 \times 10^{-5} moldm^{-3} at 25^0C$)
(01 mark)

$[H_3O^+] = \sqrt{5.5 \times 10^{-10} \times 0.01}$ ✓ ✓

$= 2.357 \times 10^{-6}$ ✓ ✓

$pH = -\log 2.357 \times 10^{-6}$ ✓ ✓

$= 5.63$ ✓ ✓

2

9

14. (a) Outline the processes involved in the large scale production of chlorine.
(no diagram required) *(03 marks)*

Electrolysis of concentrated sodium chloride (Brine) using graphite anode and mercury (or titanium cathode) anode and steel or nickel cathode). At anode, chloride ions are discharged and oxidized to chlorine gas. $2Cl^-_{(aq)} \longrightarrow Cl_{2(g)} + 2e$ ✓ 3

(b). Write equations to show how chlorine reacts with;

(i) hot concentrated sodium hydroxide solution. *(1½ marks)*

$3Cl_{2(g)} + 6OH^-_{(aq)} \longrightarrow 5Cl^-_{(aq)} + ClO^-_{3(aq)} + 3H_2O_{(l)}$ ✓ ✓

OR $3Cl_{2(g)} + 6NaOH_{(aq)} \longrightarrow 5NaCl_{(aq)} + NaClO_{3(aq)} + 3H_2O_{(l)}$ ½

(ii) Sulphur dioxide. *(1½ marks)*

$Cl_{2(g)} + SO_{2(g)} + 2H_2O_{(l)} \longrightarrow SO^{2-}_{4(aq)} + 4H^+_{(aq)} + 2Cl^-_{(aq)}$ ✓ ✓

OR $Cl_{2(g)} + SO_{2(g)} + 2H_2O_{(l)} \longrightarrow H_2SO_{4(aq)} + 2HCl_{(aq)}$ ½

(c) When reacted together, a mixture of sodium chloride and concentrated sulphuric acid liberates hydrogen chloride gas however a similar mixture of sodium iodide and sulphuric acid liberates iodine instead. Explain this observation.
(03 marks)

The hydrogen chloride liberated is a very weak ✓ reducing agent and so not affected / oxidized ✓ by concentrated sulphuric acid; however, in the case of hydrogen iodide, it is a strong ✓ reducing agent so oxidized ✓ to iodine and the acid reduced to hydrogen sulphide.

9

$SO^{2-}_{4(aq)} + 10H^+_{(aq)} + 8I^-_{(aq)} \longrightarrow H_2S_{(g)} + 4I_{2(aq)} + 4H_2O_{(l)}$ ✓ 3

OR $8NaI_{(s)} + 9H_2SO_{4(l)} \xrightarrow{12} 8NaHSO_{4(aq)} + H_2S_{(g)} + 4H_2O_{(l)} + 4I_{2(s)}$

(a) An organic compound **P** contains Carbon 80%, hydrogen, 6.7% the rest being oxygen. Determine the empirical formula of **P**. ***(2½ marks)***

C H O (100 − 86.7) = 13.3 ✓

C	H	O
80/12	6.7/1	13.3/16
6.66	6.7	0.83125 ✓
6.66/0.83125	6.7/0.83125	0.83125/0.83125 ✓

C H O
8 : 8 : 1 ✓

∴ E.F of P is C_8H_8O ✓ 2½

(b) 0.5g of **P** when vaporized at 150°C and 760mmHg occupied 144.6cm³.

(i) Determine the molecular mass of **P** and hence its molecular formula. ***(3½ marks)***

From $M_r = \frac{mRT}{PV}$ ✓

$= \frac{0.5 \times 8.314 \times 423}{101325 \times 144.6 \times 10^{-6}}$ ✓

$= 120\,g$ ✓

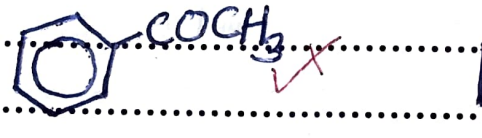
$(C_8H_8O)_n = 120$ ✓

$(96 + 8 + 16)n = 120$

$n = 1$ ✓

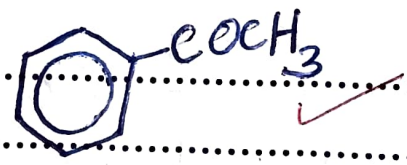
∴ MF of P is C_8H_8O ✓ 3½

(ii) Write the structures of the possible isomers of **P**. ***(01 mark)***



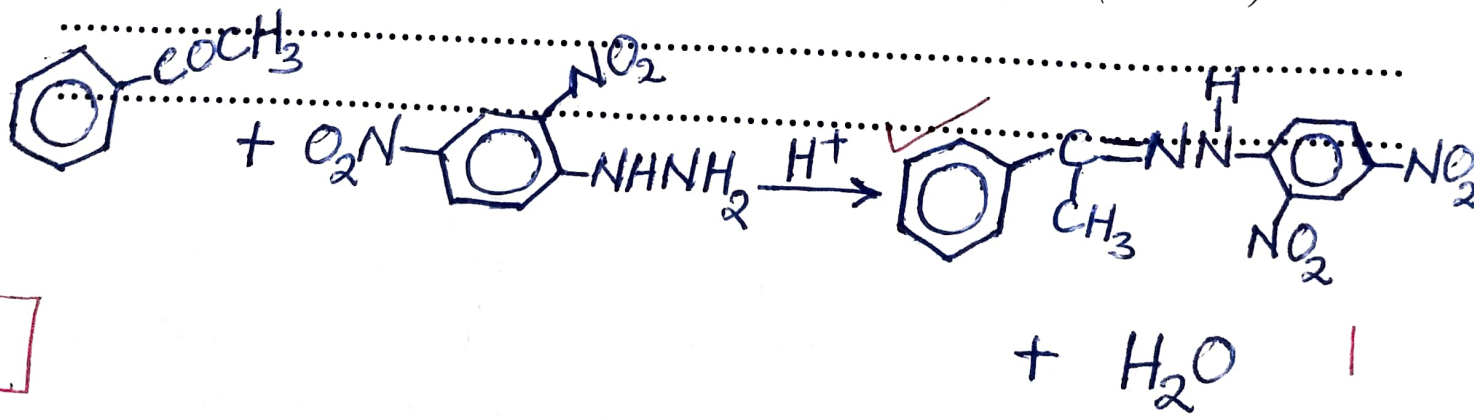
✓ ✓ 1

(c) **P** burns with a yellow sooty flame, forms a yellow orange precipitate with Brady's reagent and also reacts with iodine in sodium hydroxide to form a yellow solid. Write the structure of **P**. ***(01 mark)***



✓ 1

(d) Write equation for the reaction between **P** and Brady's reagent. ***(01 mark)***



✓ 1

9

16. (a) (i) Name the **ore** used in the extraction of aluminium. *(½ mark)*

Bauxite ✓+ ½

(ii) Write the formula of the **ore** named in (a) (i) above. *(½ mark)*

$Al_2O_3 \cdot 2H_2O$ ✓+ ½

(b) During the extraction process of alumiunium, the **ore** is treated with hot concentrated sodium hydroxide solution.

(i) Briefly state what happens to the ore when treated with sodium hydroxide solution. *(02 marks)*

The aluminium oxide in the ore dissolves ✓ to form a soluble complex of a luminate and the acidic silicon dioxide dissolves to form a silicate ✓. The iron (III) oxide remains undissolved 2

(ii) Write equations for the reactions that take place in (b) (i). *(2½ marks)*

$Al_2O_3(s) + 2\bar{O}H(aq) + 3H_2O(l) \longrightarrow 2Al(OH)_4^-(aq)$ ✓✓

OR

$Al_2O_3(s) + 2\bar{O}H(aq) \longrightarrow 2AlO_2^-(aq) + H_2O(l)$

$SiO_2(s) + 2\bar{O}H(aq) \longrightarrow SiO_3^{2-}(aq) + H_2O(l)$ ✓ 2½

(c) The soluble complex salt of aluminium obtained in (b) is taken by through several reactions to form pure aluminium oxide.

(i) State how the purified aluminium oxide is treated to form pure aluminium. *(1½ marks)*

It is dissolved in molten ✓+ cryolite and then electrolysed between graphite ✓+ electrodes, molten aluminium ✓+ is discharged at the cathode 1½

(ii) Write equation for the reaction that takes place. *(01 mark)*

$Al^{3+}(l) + 3e \longrightarrow Al(l)$ ✓ 1

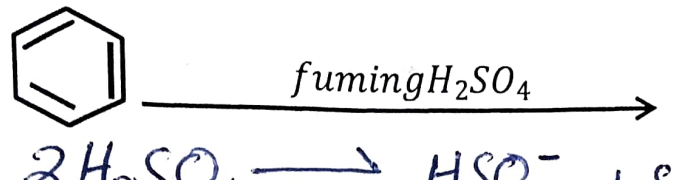
9

(iii) Explain any **one** use of aluminium. (~~1½ marks~~) 1 mark

- Making electric conducting wires since it's a good conductor of electricity. 1

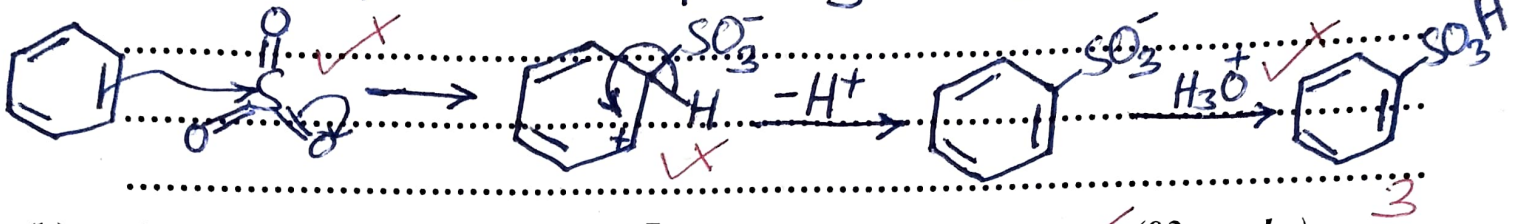
Accept any other use with a reason.

7. Complete the following reactions and in each case write a mechanism.

(a) 

(03 marks)

$2H_2SO_4 \rightleftharpoons HSO_4^- + SO_3 + H_3O^+$



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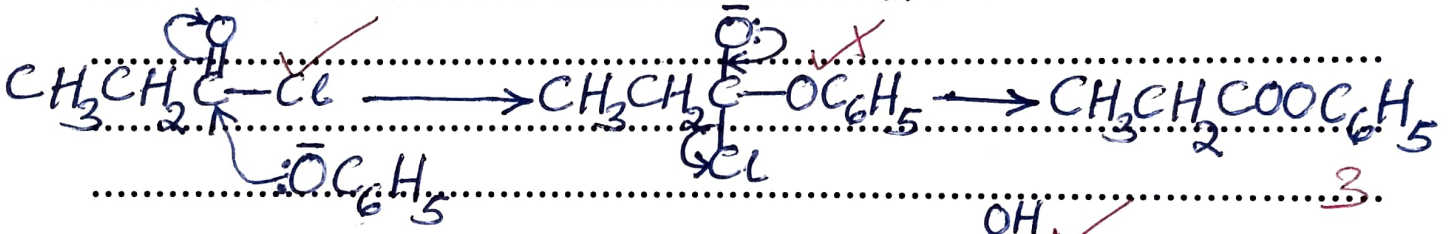
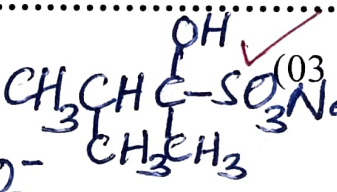
(b) CH_3CH_2COCl $\xrightarrow{C_6H_5OH/\bar{O}H}$ $CH_3CH_2COOC_6H_5$ (03 marks)

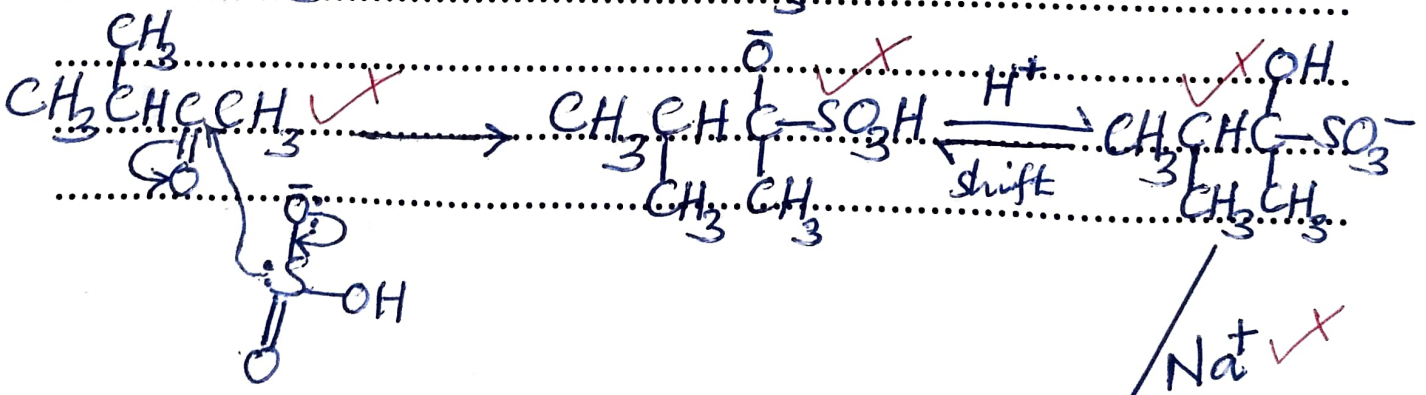
$C_6H_5OH + \bar{O}H \longrightarrow C_6H_5\bar{O} + H_2O$

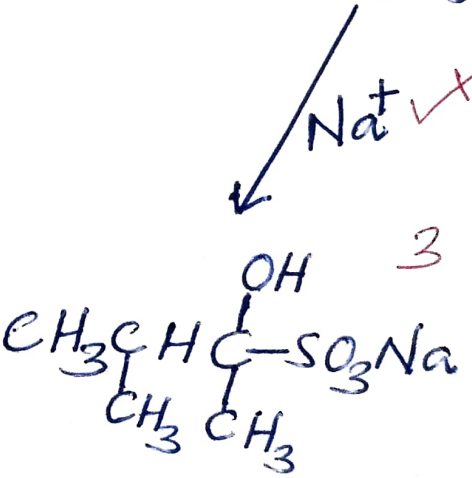


3

(c) $CH_3CHCOCH_3$ (CH_3) $\xrightarrow{NaHSO_3}$  (03 marks)

$NaHSO_3 \longrightarrow Na^+ + HSO_3^-$





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