Name:........**Marking guides** **Ocan Nelson**........Index No:..............

0784975248/
0741903056

P521/1
Chemistry
Paper 1
2¾ hours

Uganda Advanced Certificate Of Education

UACE

MOCK 2023

PAPER 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

Answer all questions in section A and six questions in section B.

Any extra questions answered will not be marked.

All questions must be answered in the spaces provided.

Illustrate your answers with equations where applicable.

Molar gas constant R=8.314 Jmol^{-1}K^{-1}.

Molar volume of gas at s.t.p is 22.4 litres.

Molar volume of gas at room temperature is 24 litres.

For Examiners Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
				4	6				9	9	9	9	9	9	9	9~100%	

Please Turn Over

1

SECTION A (46 marks)
Answer all questions

1. Potassium permanganate is preferred to potassium dichromate in standardizing sodium ethanedioate although it's not considered as a primary standard.

   (a) Explain what is meant by the term **primary standard.** *(01 mark)*

   Is a solution of high purity and a known concentration, that is used to accurately and precisely determine the concentration of other soln in a chemical analysis;

   [res without known []]

   (b) State reason(s) why potassium permanganate is preferred to potassium dichromate. *(02 marks)*

   Accept other appropriate reason(s)

   [res; High Rxum]

   Potassium Manganate (VII) can act as a self indicator; ☑02
   Potassium Manganate (VII) is a stronger oxidising agent than $K_2Cr_2O_7$.

   (c) (i) State the condition(s) for the reaction of potassium permanganate with sodium ethanedicate. *(01 mark)*

   Accept Heat;   Accept temp of 75°C;
   Heating to a temp > 75°C;
   Conc: H_2SO_4; or dilute Sulphuric Acid; res Acidified ----
   [res'. Acidic; medium;]

   (ii) Write equation for the reaction that takes place in (c) (i). *(1½ marks)*

   Accept Nil euler

   $$2MnO_4^-{(aq)} + 16H^+{(aq)} + 5C_2O_4^{2-}{(aq)} \rightarrow 2Mn^{2+}{(aq)} + 10CO_2{(g)} + 8H_2O{(l)}$$

2. (a) Complete the following organic reaction and outline the reaction mechanism. *(3½ marks)*

   [Edgh]

   Fe/Br₂ / heat → Br + HBr; ③h

   stop awarding If any arrow misses on initial steps

   Mechanism

   $2Fe + 3Br_2 \rightarrow 2FeBr_3$
   $Br_2 + FeBr_3 \rightarrow Br-Br ---- AlBr_3$ ($\delta+$ $\delta-$)
   $-H^+$ → Br;
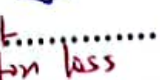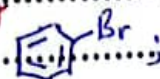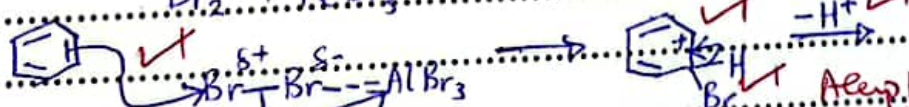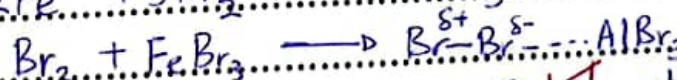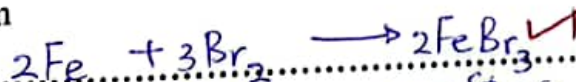
   Bonds shd be touching   Accept [+]-Br   Accept ... Do not Award if arrow not touching;
   Steps with; I   Accept Br—Br AlBr₃ etc
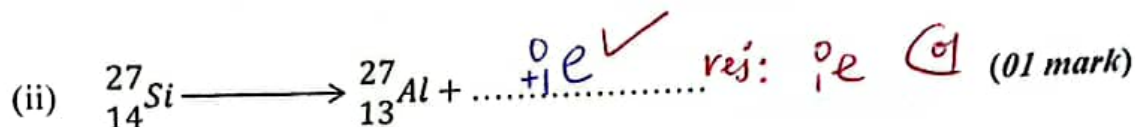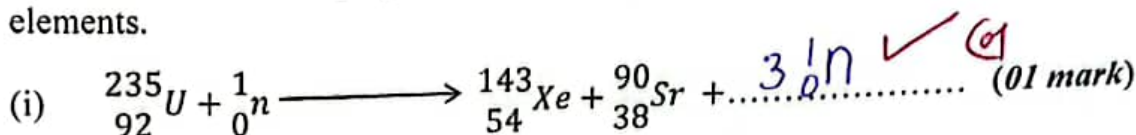
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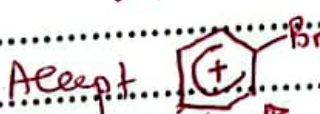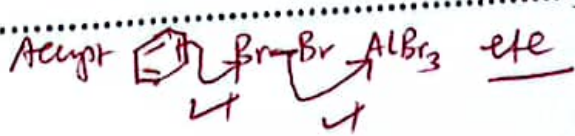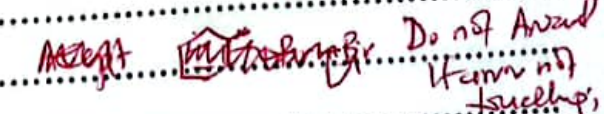
(b) Name the type of reaction mechanism that takes place in (a) above.

f rej: If spellings not correct;   *(01 mark)*

...... Electrophilic Substitution reaction; ✓ ① ....

3. Complete the following equations for nuclear reactions by identifying the missing elements.

(i) $^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{143}_{54}Xe + ^{90}_{38}Sr + \underline{3\, ^{1}_{0}n}$ ✓ ①   *(01 mark)*

(ii) $^{27}_{14}Si \longrightarrow ^{27}_{13}Al + \underline{^{0}_{+1}e}$ ✓   *rej: $^{0}_{1}e$* ①   *(01 mark)*

(iii) $^{232}_{90}Th \longrightarrow$ ...... *Not Awarded; not Awarded; info; not adequate;* ...... *(02 marks)*

4. **(a)** During manufacture of nitric acid, ammonia is catalytically oxidized.
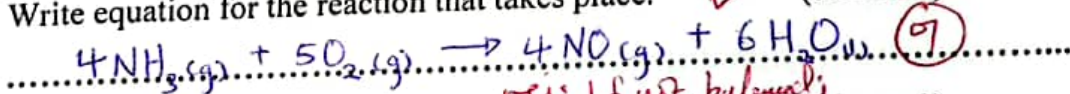
(i) Name the catalyst used.   *(½ mark)*

...... Platinum Catalyst; ✗ *Accept* Rhodium gauze Catalyst ......

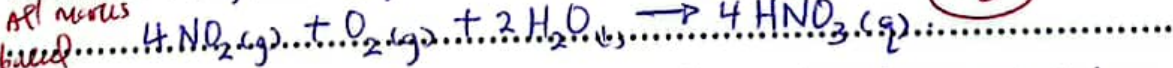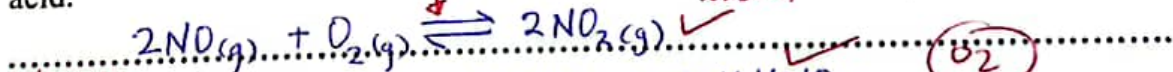(ii) Write equation for the reaction that takes place. ✓   *(01 mark)*

...... $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(v)$ ① ......

rej: If not balanced;

(iii) State other specific conditions for the reaction.   *(01 mark)*

...... High temp ✓ *or* 800 - 900°C; ......
...... High pressure; ✓ ① ...... *Accept quotation within the range; i.e. 850°C*

(b) Write other equation(s) for the reactions involved during manufacture of nitric acid.

f deduct ½ if reversible sign missing *(02 marks)*

...... $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$ ✓ ...... ②

Deny All marks if not balanced ...... $4NO_2(g) + O_2(g) + 2H_2O(l) \longrightarrow 4HNO_3(g)$ ......

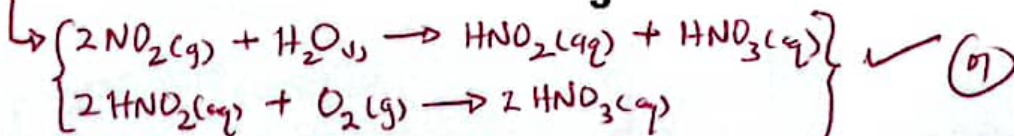**(c)** Write equation for the reaction that takes place when moderately concentrated nitric acid is reacted with copper metal.   *(1½ marks)*

Accept ...... ✓✓✗ ...... ①½

...... $3Cu(s) + 8HNO_3(aq) \longrightarrow 3Cu(NO_3)_2(aq) + 2NO(g) + 4H_2O(l)$ ......

...... *deduct ½ allow for any chile;* ......

3

$\Rightarrow \begin{cases} 2NO_2(g) + H_2O(l) \longrightarrow HNO_2(aq) + HNO_3(g) \\ 2HNO_2(aq) + O_2(g) \longrightarrow 2HNO_3(aq) \end{cases}$ ✓ ①
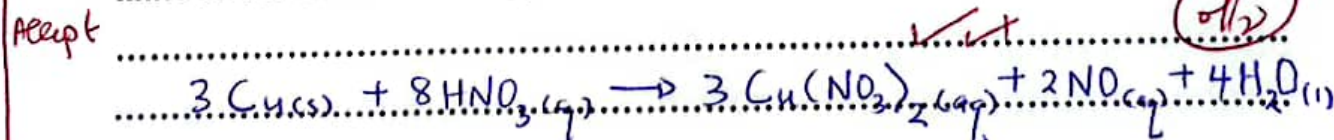
5. (a) Explain what is meant by the term **steam distillation.** (1½ marks)

Is a technique of separating a volatile substance immiscible with water from a non-volatile substance also immiscible with water by passing steam through the heated mixture at a temp: lower the B.point of two substances. (1½)

(b) A liquid compound X which is immiscible with water forms a mixture with water that boils at 97^0C at a pressure of 1.0×10^5 Pascals. The vapour pressure of water at that temperature is 96kPa. The relative molecular of X is 125. Calculate the percentage composition of X in the distillate. (03 marks)

let the % composition of X in the distillate be a %

% composition of water in the residue = (100-a) %

$$= \frac{\text{Molar Mass} \times V.P \text{ of } X}{\text{Molar Mass of } H_2O \times V.P \text{ of } H_2O}$$

res: If the formula is $\frac{a}{100-a}$ not correct;

$$\frac{a}{100-a} = \frac{125 \times 4000}{18 \times 96000}$$ (03)

a = 22.44%

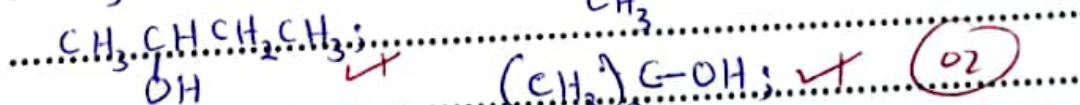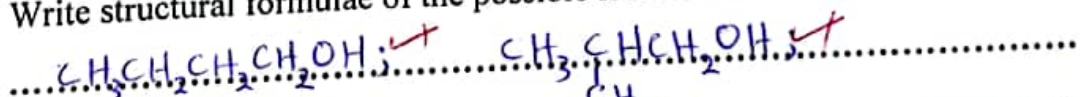i.e. The percentage composition of X in the distillate is 22.44%.

6. (a) An organic compound Z has molecular formula C_4C_{10}. Compound Z forms misty fumes with phosphorous pentachloride.

(i) Name the functional group in Z. (½ mark) (½) res: Alcohol

deny if the spelling is not correct;

⇒ Hydroxyl groups;
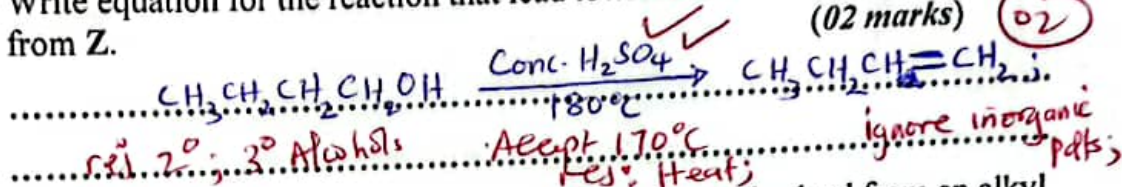
(ii) Write structural formulae of the possible isomers of Z. (02 marks)

$CH_3CH_2CH_2CH_2OH$;

$CH_3.CHCH_2CH_3$;
       $\overset{|}{OH}$

$CH_3.CHCH_2OH$;
       $\overset{|}{CH_3}$
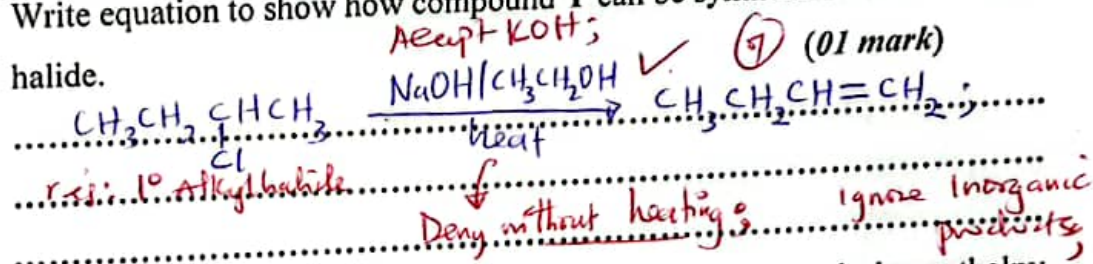
$(CH_3)_3C-OH$; (02)

Award ½ mark for @ isomers;

4

(b) Z shows no observable change with anhydrous zinc chloride and concentrated hydrochloric acid at room temperature. On heating Z with concentrated sulphuric acid it formed compound Y and Y yielded two products on ozonolysis. Both products formed yellow precipitate with Bradys reagent however one the products gave silver mirror with ammoniacal silver nitrate solution while the other did not.
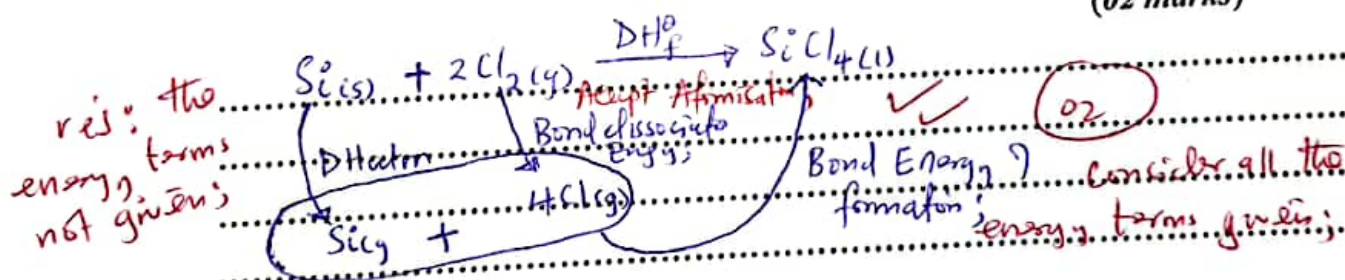
(i) Write equation for the reaction that lead towards formation of compound Y from Z. *(02 marks)* ⓿②

(handwritten)
$$CH_3CH_2CH_2CH_2OH \xrightarrow[180°C]{Conc. H_2SO_4} CH_3CH_2CH=CH_2 ;$$
rej: 2° ; 3° Alcohols · Accept 170°C · ignore inorganic products;
rej: Heat;

(ii) Write equation to show how compound Y can be synthesized from an alkyl halide. *(01 mark)* ⑦

Accept KOH;
(handwritten)
$$CH_3CH_2\underset{Cl}{CHCH_3} \xrightarrow[heat]{NaOH/CH_3CH_2OH} CH_3CH_2CH=CH_2 ;$$
rej: 1° Alkyl halide.
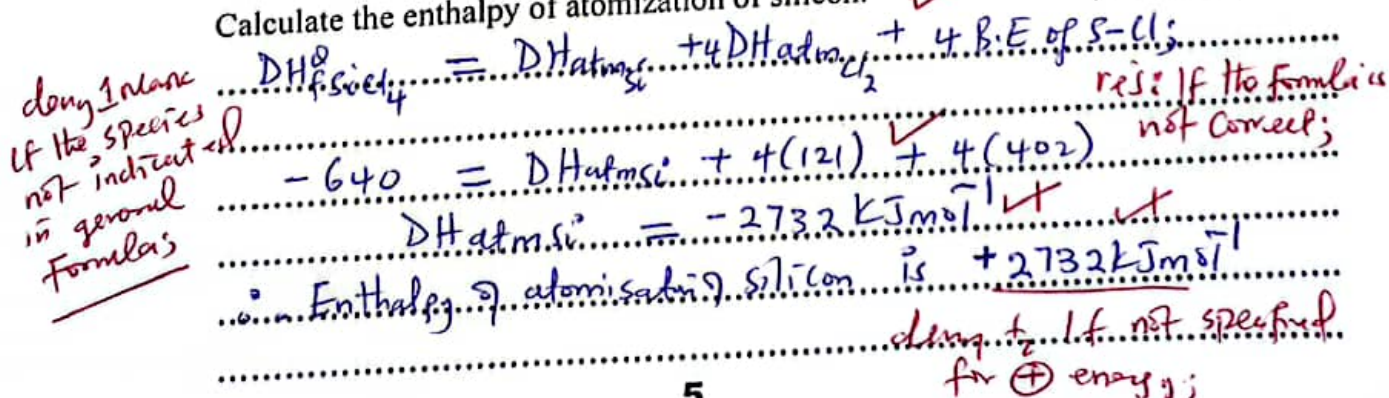Deny without heating;   Ignore Inorganic products;

7. (a) Draw a born haber cycle showing the enthalpy changes that occur during enthalpy formation of silicon (IV) chloride. Indicate all the energy terms involved. *(02 marks)*
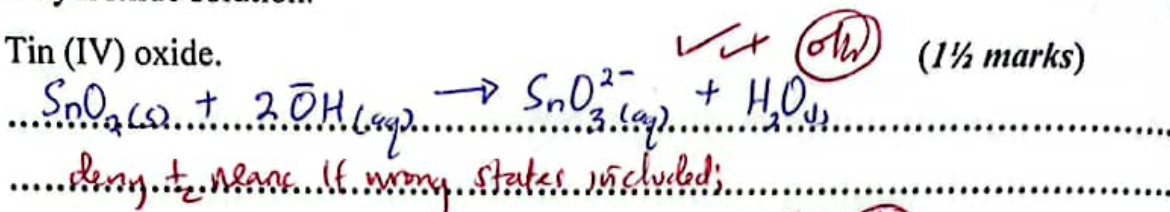
rej: the energy terms not given;

(handwritten born haber cycle)
$$Si(s) + 2Cl_2(g) \xrightarrow{DH_f°} SiCl_4(l)$$
Accept Atomisation
·DH atom· Bond dissociation Engy;
ΔH.f.Cl(g) · Bond Energy? Consider all the formation energy terms given;
SiC₄ +   ⓿②

(b) The following enthalpy changes are given;

Enthalpies of atomization of chlorine	=	$+121\,kjmol^-$.
The bond energy of $Si - Cl$	=	$402\,kjmol^-$
Enthalpy of formation of silicon(IV) chloride	=	$-640\,kjmol^{-1}$

Calculate the enthalpy of atomization of silicon. *(03 marks)*

(handwritten)
deny 1 mark if the species not indicated in general formulas

$$DH_{f}°SiCl_4 = DH\,atom_{Si} + 4DH\,atom_{Cl_2} + 4\,B.E \text{ of } S-Cl;$$
rej: if the formula is not correct;
$$-640 = DH\,atom.Si + 4(121) + 4(402)$$
$$DH\,atom.Si = -2732\,KJmol^{-1}$$
∴ Enthalpy of atomisation Silicon is $+2732\,KJmol^{-1}$
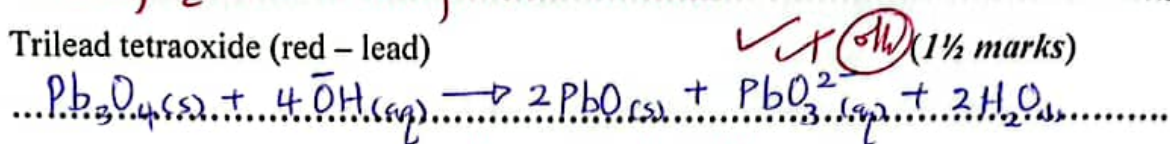deny t₂ if not specified for ⊕ energy;

5

8. Write equations for the reactions that take place when the following react with aqueous sodium hydroxide solution.
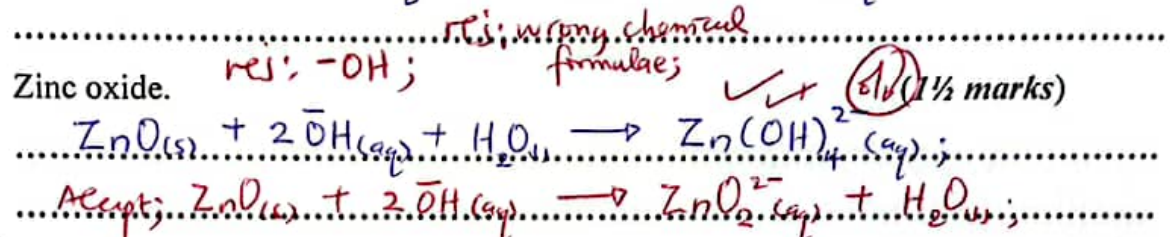
(a) Tin (IV) oxide. ✓+ (oh) *(1½ marks)*

$$SnO_{2(s)} + 2\bar{O}H_{(aq)} \longrightarrow SnO_{3(aq)}^{2-} + H_2O_{(l)}$$

deny $\frac{1}{2}$ mark. If wrong states included;

(b) Trilead tetraoxide (red – lead) ✓+ (oh) *(1½ marks)*

$$Pb_3O_{4(s)} + 4\bar{O}H_{(aq)} \longrightarrow 2PbO_{(s)} + PbO_{3(aq)}^{2-} + 2H_2O_{(l)}$$

rej; wrong chemical formulae;

rej; −OH;

(c) Zinc oxide. ✓+ (oh) *(1½ marks)*

$$ZnO_{(s)} + 2\bar{O}H_{(aq)} + H_2O_{(l)} \longrightarrow Zn(OH)_{4(aq)}^{2-};$$

Accept; $ZnO_{(s)} + 2\bar{O}H_{(aq)} \longrightarrow ZnO_{2(aq)}^{2-} + H_2O_{(l)};$

9. (a) A cyclic hydrocarbon **Q** contains by mass 12.20% hydrogen and has density of $3.42g\ dm^{-3}$ at room temperature. Determine the empirical formula of **Q**.

(02 marks)

Element	C	H ;	Mole ratio $\frac{7.31667}{7.31667}$: $\frac{12.20}{7.31667}$ ✓
% Composition;	87.8	12.20	(1 : 1.667) .3
No of moles;	$\frac{87.8}{12}$	$\frac{12.20}{1}$ ✓	Simplest Mole ratio 3 : 5 ✓ rej; roundings;
	7.31667	12.20	∴ Empirical formula is C_3H_5 ✓

rej; roundings; 02

∴ Empirical formula is C_3H_5 ✓

(b) (i) Determine molecular formula of **Q**. *(02 marks)*

$1dm^3$ of Q weighs 3.42 g.

$24dm^3$ of Q weighs (3.42×24) g

$= 82.08g$ ✓

$41n = 82.08$

$n \approx 2;$ ✓

Molecular Formula?

02

Then; $(C_3H_5)_n = 82.08$ ✓

$(12 \times 3 + 1 \times 5)_n = 82.08$

rej; The step If empirical formula is not correct;

Q is C_6H_{10}; rej; if value of $n \neq 2$

rej; the value of n If RMM isn't correct;

(ii) Write down the structural formula of **Q** and name the compound. *(01 mark)*

✓ . ✓

Cyclohexene deny $\frac{1}{2}$ mark If Its separated;
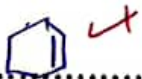
(one word)

rej; If the molecular Formula is wrong

Answer six questions

10. (a) Complete the following the table given below; **(04 marks)**

Compound	Structure	Type of bond
Calcium fluoride	Cubic Crystal lattice *(Accept: Cubic face-centred cubic close-packed)*	Ionic;
Silicon (IV) oxide	Giant Covalent	Covalent
Iodine	face-Centered Cubic	Covalent
Aluminium chloride	Cubic-close packed	Covalent

rej: If the structure is not correct;
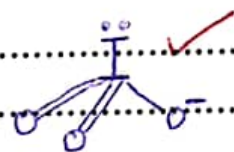
04

(b) Draw the structure and name the shape of;

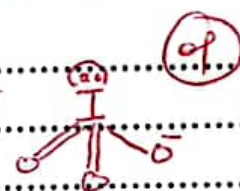(i) IO_3^-

Structure **(01 mark)**

rej: I for Iodine;
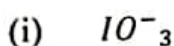
rej: structure if the bonds are not touching;   *accept*   *of*

Shape **(½ mark)**

Trigonal Pyramidal; *attached to b(i); deny if b(i) is not correct;*

(b) Potassium iodide solution was added to a solution containing the compound in (b) in presence of dilute sulphuric acid.

Award 1 Mark for both observations

(i) State what was observed. **(01 mark)**

Colourless Soln turns to brown Soln;

(ii) Write equation for the reaction that takes place. **(1½ marks)**
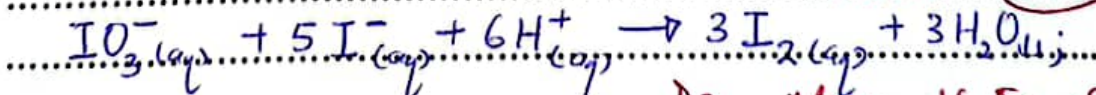
Accept molecular eqn;

$$IO_{3\ (aq)}^- + 5I_{(aq)}^- + 6H_{(aq)}^+ \longrightarrow 3I_{2\ (aq)} + 3H_2O_{(l)};$$

Deny Mark if Eqn not Balanced;

CamScanner

(c) An aqueous solution of potassium iodide was added to iodine. Write equation for the reaction that took place. (1½ marks)

rej: 1 Symbol for Iodine

$I^-_{(aq)} + I_{2\,(aq)} \rightleftharpoons I^-_{3\,(aq)}$ — deny ½ marc if the reversible sign is missing;

(½)

deny ½ marc for wrong states; (03 marks)

11. (a) $(CH_3)_2CO \xrightarrow{\quad NaHSO_3 \quad} CH_3\overset{OH}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}-SO_3Na$

Mechanism

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

Na $\overset{+}{}$

- Stop award if any relevant step is missing
- Bonds should be touching

$CH_3\overset{O}{\overset{||}{C}}-CH_3 \longrightarrow CH_3\overset{O^-}{\overset{|}{C}}-CH_3 \rightleftharpoons$ H+ shift $CH_3\overset{OH}{\underset{SO_3^-}{\overset{|}{\underset{|}{C}}}-CH_3$

Accept →

HO–S=O ... O↑ Rej: wrong structures;

HO–S=O O

CH_3 ↙ Accept

MX ③

[Ignore Inorganic pdts]

(b) $(CH_3)_3CBr \xrightarrow{\quad CH_3CH_2O^-/OH^- \quad} CH_3-\overset{CH_3}{\overset{|}{C}}=CH_2 + HBr$ (03 marks)

Mechanism

Accept –Br⁻

deny ½ Mark is ($\rightleftharpoons$) is missing;

- Arrows should be touching
- Also, bonds shd be touching;

Mechanis; $(CH_3)_3C{-}Br \rightleftharpoons (CH_3)_3\overset{+}{C} + Br^- $

Only Accept SN₁.

$CH_3-\overset{CH_3}{\underset{}{\overset{+}{C}}}{-}CH_2 \longrightarrow CH_3\overset{CH_3}{\overset{|}{C}}=CH_2 $

$\ddot{O}CH_2CH_3$

Accept $\ominus\ddot{O}CH_2CH_3$

MX ③

(c)

 – CH₃ $\xrightarrow{\quad H_2O/H^+ \quad}$ CH₃ OH; (03 marks)

Mechanism

–CH₃ H⁺ →P. +–CH₃ ÖH₂ → –CH₃ +O–H

rej: If ⊕ not on oxygen;

Do not continue with awarding if arrows are not touching

$\swarrow$ –H⁺

 CH₃ OH; up

03

 +–CH₃ ÖH₂

Do not Award if arrow is touching the angle indicated above;

8
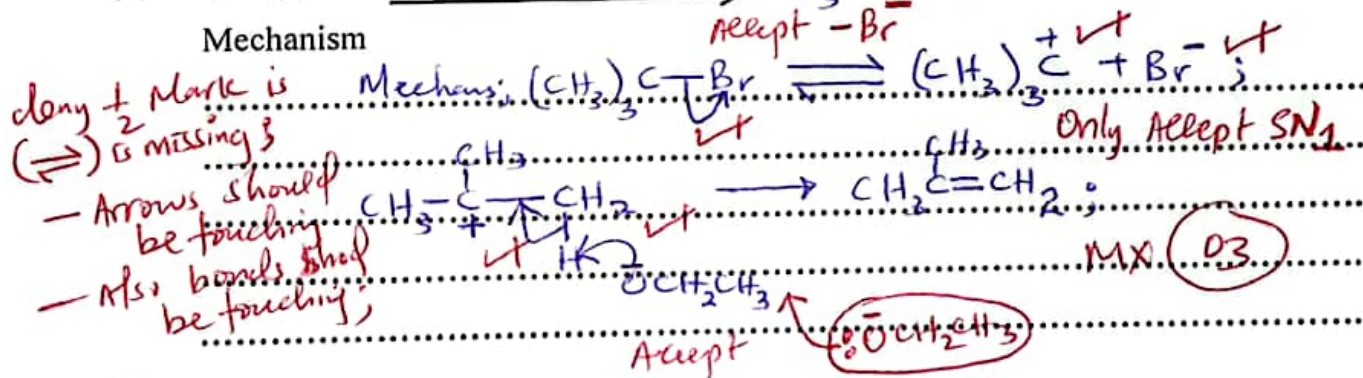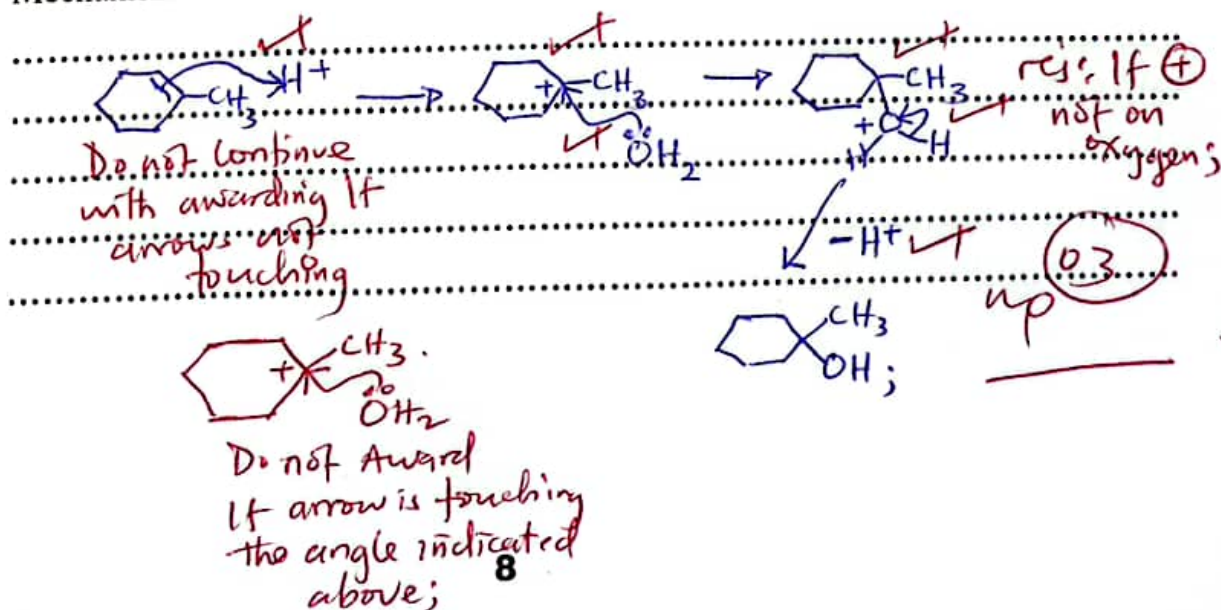
12. The following half-cell reactions are given;

$$E^0/V$$

$$I_{2(aq)} + 2e \longrightarrow 2I^-(aq) \qquad +0.34$$

$$PbO_{2(s)} + 4H^+_{(aq)} + 2e \longrightarrow Pb^{2}(aq) + 2H_2O_{(l)} \qquad +1.46$$
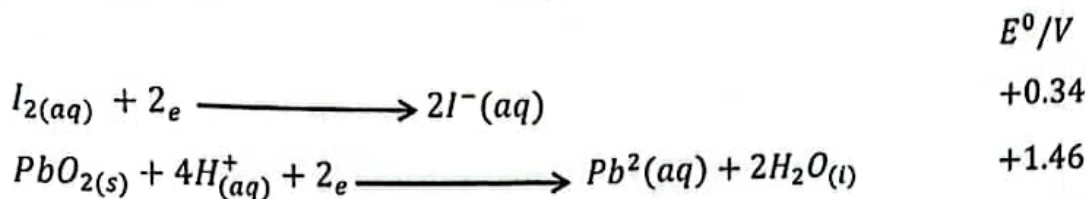
(a) (i) Write the cell notation for the cell formed by combining the two half cells.

(02 marks)

rej: without Pt(s)

Accept $Pb^{2+}_{(aq)}, H_2O_l$

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

Accept with H_2O;

Ie $PbO_{2(s)} | H^+_{(aq)}, Pb^{2+}_{(aq)} | H_2O_l$

(ii) State what will be observed at the;

(01 mark)

rej: Equations

Anode   Colourless solution turns to brown solution; ① ......

(01 mark)

Cathode   Brown solid dissolves to form Colourless solution; ① ......

Accept (Dark brown)

(1½ marks)

(b) Calculate the e.m.f for the cell.

$E^0_{cell} = E_{Right} - E_{left}$ (Accept $E^0_{cell} = E_{cathode} - E_{left}$).

Deny ½ Mark if formula missing

$= +1.46 - (+0.34)$ [or $E^0_{cell} = E_{Reduction} - E_{oxidation}$]

$= +1.12V$ rej: without ⊕ and units missing thus deny ½ Mark; for Ans.

(c) State whether the reaction is feasible or not. Give reason for your answer.

(1½ marks)

Feasible; because e.m.f of the cell is Positive

rej: if (b) is not Correct; ...... ⊘½

(d) State the factors that influence the magnitude of the standard electrode potential.

(1½ marks)
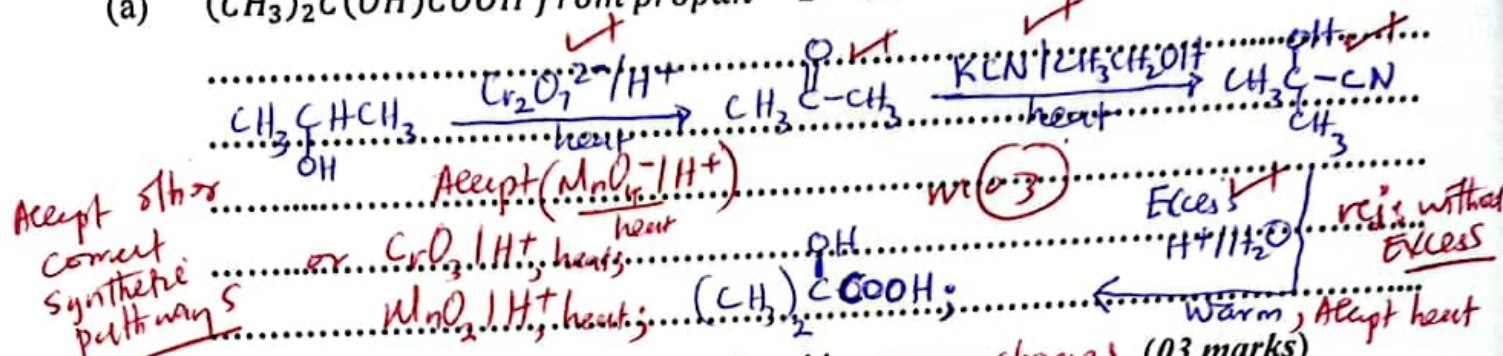
Atomisation energy; ......

Ionisation energy; ...... ⊘½ ......

Hydration Energy; ......

(e) State **one** application of standard electrode potential.

(½ marks)

Predicting feasibility of redox rxns; ...... ½ ......

Accept any other(s) which is correct. Application.

{ Determining relative strength of oxidising & Reducing Agents;

{ Designing electrochemical cells;

9

13. Write equations to show how the following synthesis can be carried out. In each case indicate the necessary reagents and conditions.

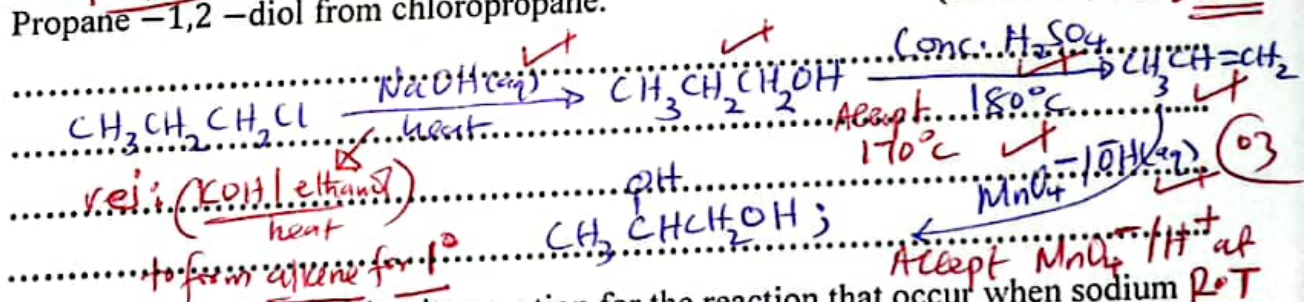*Accept* $HCN/\bar{O}H$ (03 marks)

(a) $(CH_3)_2C(OH)COOH$ from $propan-2-ol$

$$CH_3CHCH_3 \xrightarrow[\text{heat}]{Cr_2O_7^{2-}/H^+} CH_3\overset{O}{\underset{}{C}}-CH_3 \xrightarrow[\text{heat}]{KCN/CH_3CH_2OH} CH_3\underset{CH_3}{\overset{OH}{C}}-CN$$

Accept (MnO_4^-/H^+) heat

$Accept$ other correct synthetic pathways

or CrO_3/H^+, heat;

MnO_2/H^+, heat; $(CH_3)_2\overset{OH}{C}COOH;$

wt (03)

Excess H^+/H_2O ← Warm, Accept heat

rej's without Excess

(b) Chlorobenzene to benezene sulphonic acid. + Ignore charges (03 marks)

deny without(cq)

 $\xrightarrow[360°C, 150atm]{NaOH(aq)}$ $\bar{O}Na^+ \xrightarrow{\text{dilute HCl}}$ OH ignore state

deny if temp and presue n? spenfied

 $SO_3H;$ $\xleftarrow[\text{heat}]{Conc. H_2SO_4}$ Accept (fuming) H_2SO_4 heat Reflux Conc. H_2SO_4 + Zn(s) dust → (03) rej: Heat

(03 marks)
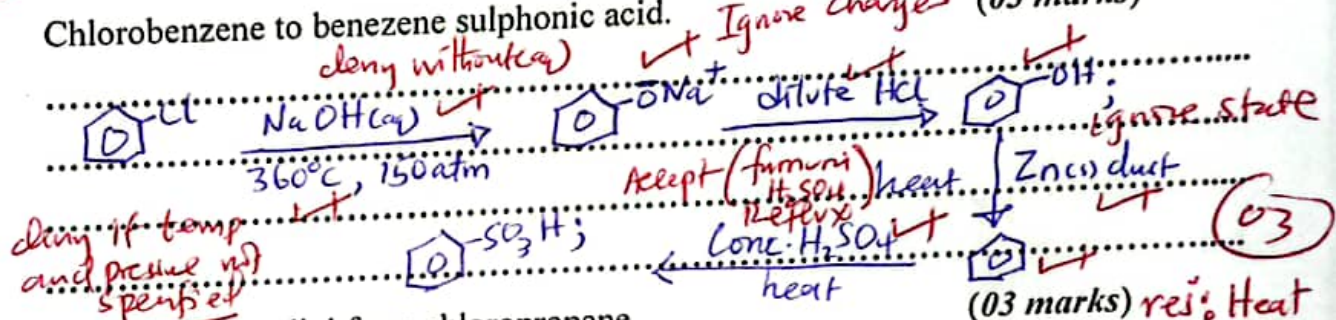
(c) Propane $-1,2-$diol from chloropropane.

Accept other Synthetic pathways that are correct;

$$CH_3CH_2CH_2Cl \xrightarrow[\text{heat}]{NaOH(aq)} CH_3CH_2CH_2OH \xrightarrow[180°C]{Conc. H_2SO_4} CH_3CH=CH_2$$

rej: (KOH/ethanol) heat to form alkene for 1°

$CH_3CHCH_2OH;$

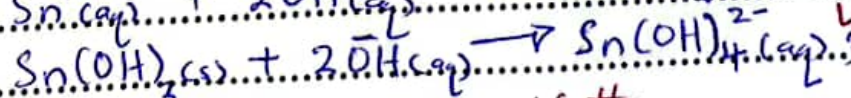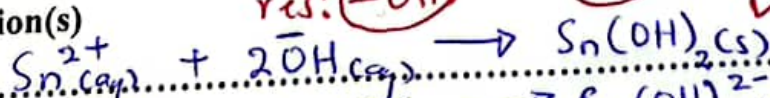170°C $\xrightarrow[]{MnO_4^-/\bar{O}H(aq)}$ (03)

Accept MnO_4^-/H^+ at R.T

14. State what will be observed and write equation for the reaction that occur when sodium hydroxide solution is added drop wise until in excess to a solution of;

(a) Tin (II) nitrate. (01 mark)

Observation.
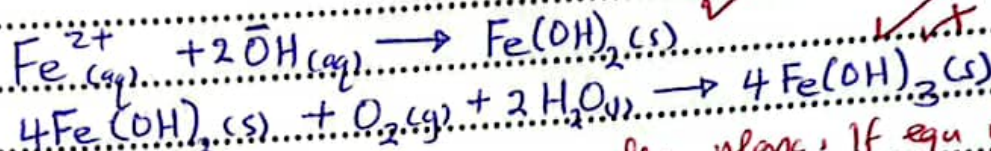white precipitate Soluble in excess

Accept ppt

rej: (−OH) Accept (OH⁻)

Equation(s) (02 marks)

$$Sn^{2+}_{(aq)} + 2\bar{O}H_{(aq)} \longrightarrow Sn(OH)_{2(s)}$$

$$Sn(OH)_{2(s)} + 2\bar{O}H_{(aq)} \longrightarrow Sn(OH)_4^{2-}_{(aq)};$$

deny Marc if the eqn not balanced;

Ignore the states

CamScanner

(b) Iron (II) sulphate   *(1½ marks)*

Observation

Acept Dirty green ppt ...green precipitate insoluble in excess turns to...... ⟨1½⟩

......brown precipitates on standing. ......

Acept ppt   *(2½ marks)*

Equation(s)

$$Fe^{2+}_{(aq)} + 2\bar{O}H_{(aq)} \longrightarrow Fe(OH)_2(s)$$

$$4Fe(OH)_2(s) + O_2(g) + 2H_2O_{(l)} \longrightarrow 4Fe(OH)_3(s)$$

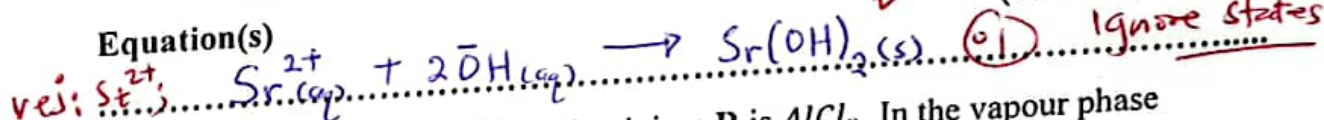*deny mark if equ not balanced*

                                                                              (01 mark)

(c) Strontium ethanoate.   ⟨1⟩

Observation

......White precipitates insoluble in excess ......

                                                                              (01 mark)

Equation(s)

rej: Sr^{2+}; $$Sr^{2+}_{(aq)} + 2\bar{O}H_{(aq)} \longrightarrow Sr(OH)_2(s)$$ ⟨01⟩ *Ignore states*

15. The empirical formula of a chloride of aluminium **R** is $AlCl_3$. In the vapour phase 0.6g of **R** occupied 75.0cm³ at 250°C and at a pressure of 132.5kPa.

deny Marks if molar mass is not lowest *(3½ marks)*

(a) Determine the molecular formula of **R.**

$$PV = \frac{mRT}{M_r}$$

$$132500 \times 75.0 \times 10^{-6} = \frac{0.6 \times 8.314 \times 523}{M_r}$$

$$M_r = 262.4 \ g \quad \text{Ignore units}$$

Then; $(AlCl_3)_n = 262.4$

$(27 + 35.5 \times 3)n = 262.4$

$\frac{whole}{number} = n \approx 2.$

The molecular Form^n of **R** is Al_2Cl_6.

deny if $n \neq 2$ (whole number). ⟨3½⟩

                                                                              (01 mark)

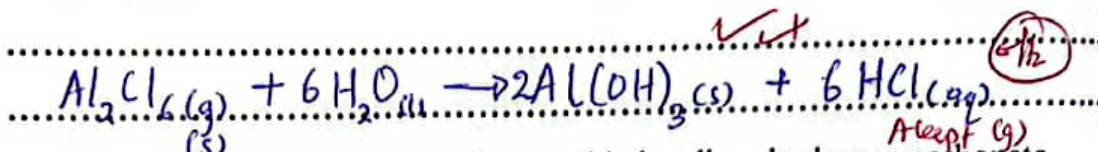**(b)** Draw the structure of **R** in the vapour phase.

⟨6⟩

– rej: If → Missing; attached to molecular formula; deny marks if Molar mass is not come here molecular formula;
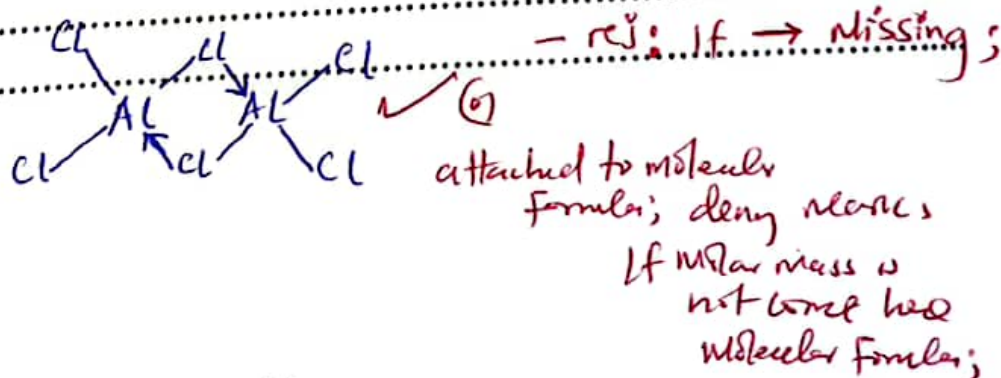
(c) Solid **R** was dissolved in water.

(i) Write equation for the reaction that took place. *(1½ marks)*

rej: $AlCl_3$

$$Al_2Cl_{6(s)} + 6H_2O_{(l)} \rightarrow 2Al(OH)_{3(s)} + 6HCl_{(aq)}$$

Accept (g)

(ii) To the resultant solution in (c) (i) was added sodium hydrogen carbonate. State what was observed and write equation for the reaction that took place.
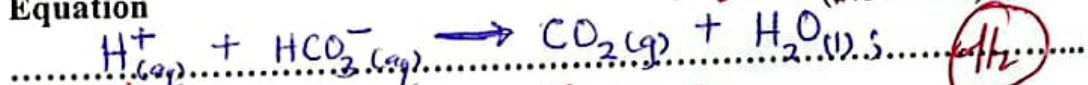
Observation Accept effervescence; ✓ *(01 mark)*

Bubbles of a colourless gas that turns lime water milky.

Equation ✓ ✓ *(1½ marks)*

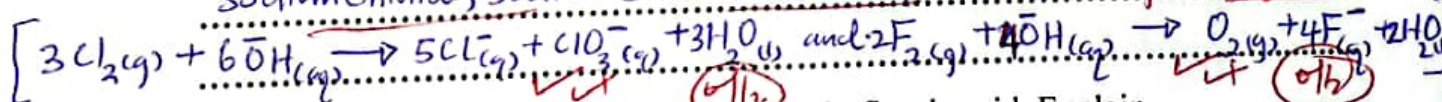$$H^+_{(aq)} + HCO^-_{3(aq)} \rightarrow CO_{2(g)} + H_2O_{(l)}$$

Accept H_3O^+ when used; Accept Molecular Eqns

16. **(a)** Compare the reaction of fluorine and chlorine with concentrated sodium hydroxide solution. *(03 marks)*

Accept Conditions hot Conc. NaOH

Fluorine react with hot Conc. NaOH; to form sodium flouride; oxygen and water; where as Cl_2 react with hot Conc NaOH; to form Sodium chloride; sodium chlorate(V) and water; Accept Eqns

$$3Cl_{2(g)} + 6OH^-_{(aq)} \rightarrow 5Cl^-_{(aq)} + ClO^-_{3(aq)} + 3H_2O_{(l)} \quad and \quad 2F_{2(g)} + 4OH^-_{(aq)} \rightarrow O_{2(g)} + 4F^-_{(aq)} + 2H_2O_{(l)}$$

(b) Hydrochloric acid is a stronger acid than hydrofluoric acid. Explain. *(03 marks)*

H–Cl bond is weaker; than H–F bond; because chlorine atom is less electronegative than Flourine atom in HF.; The weaker H–Cl bond easily breaks; forming a stable Cl^- in soln than F^- in solns. Also HF is capable of hydrogen bonds formation thus forms Intermolecular hydrogen bonds with other HF molecules; thus Makes it hard for H^+ to be formed from HF.; thus weaker acid than HCl;

rej: F^-; HF; HCl; H–Cl; H–F; used in the explanat

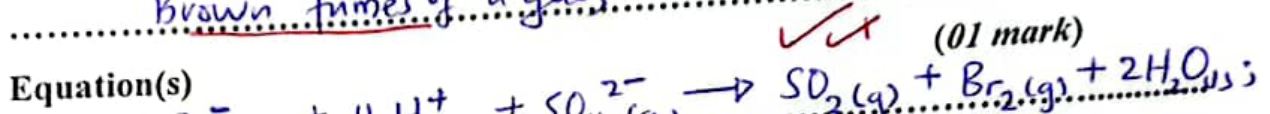Accept r~ease of formation of H^+ and ↳ The stability of Halide ion; and ↳ The Hydrogen bonding effect;

(c) Write equation for the reaction that takes place when hydrofluoric acid is added to silicon (IV) oxide.

rej: H_2SiF_6 ✓✗ **(1½ marks)** ⓗ

$$SiO_{2(s)} + 4HF_{(aq)} \longrightarrow SiF_{4(aq)} + 2H_2O_{(l)}$$
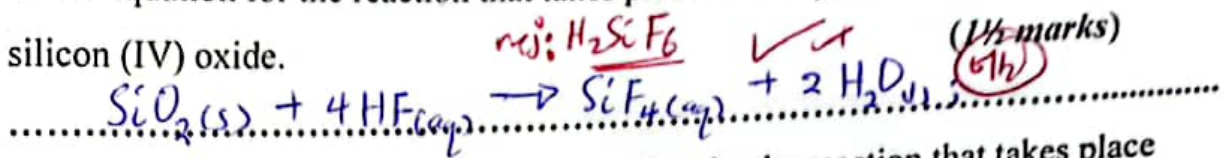
(d) State what will be observed and write equation for the reaction that takes place when a few drops of concentrated sulphuric acid is added to solid potassium bromide.

(½ mark)

Observation *rej: Brown solution;* ✗✗ ⓗ

Brown fumes of a gas; ✓✗ **(01 mark)**

Equation(s)

Accept Molecular Eqn (red)

$$2Br^-_{(aq)} + 4H^+_{(aq)} + SO_4^{2-}_{(aq)} \longrightarrow SO_{2(g)} + Br_{2(g)} + 2H_2O_{(l)};$$

Accept $Br_{(s)}$ = solid potassium bromide;   *rej: H_2S;*
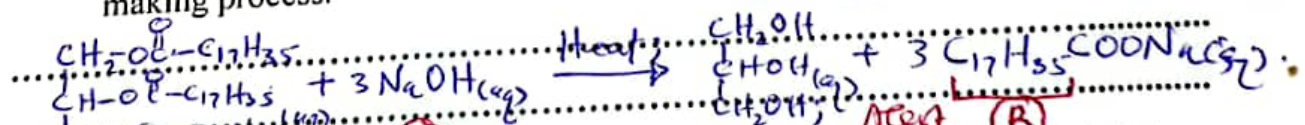
(01 mark)

17. (a) What is soap?

Sodium salt or potassium salt of long chain ✓ ⓐ
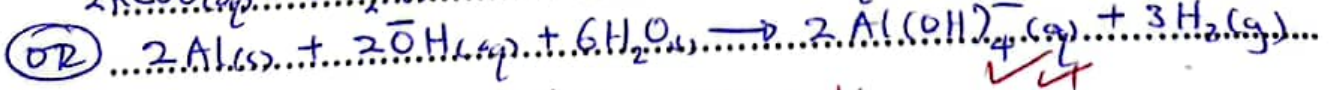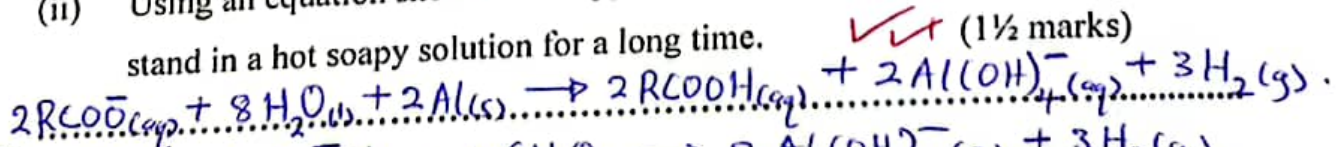Carboxylic Acids;

Award ½ If Na^+ or K^+ salt missing

(b) Briefly state how soap can be made in an ordinary laboratory from a named plant material. [Simsim oil; groundnut oil; sunflower oil] vegetable oil; Accept Any; **(2½ marks)**

rej: without specifying the vegetable oil; (red)

Sunflower oil is mixed with conc. NaOH soln and mixture heated; then mixture cooled; NaCl(aq) is then added to precipitate the soap; 2½

(c) (i) Write equation for the chemical reactions that takes place during the soap making process. ✓ ⓐ **(01 mark)** *Ignore state*
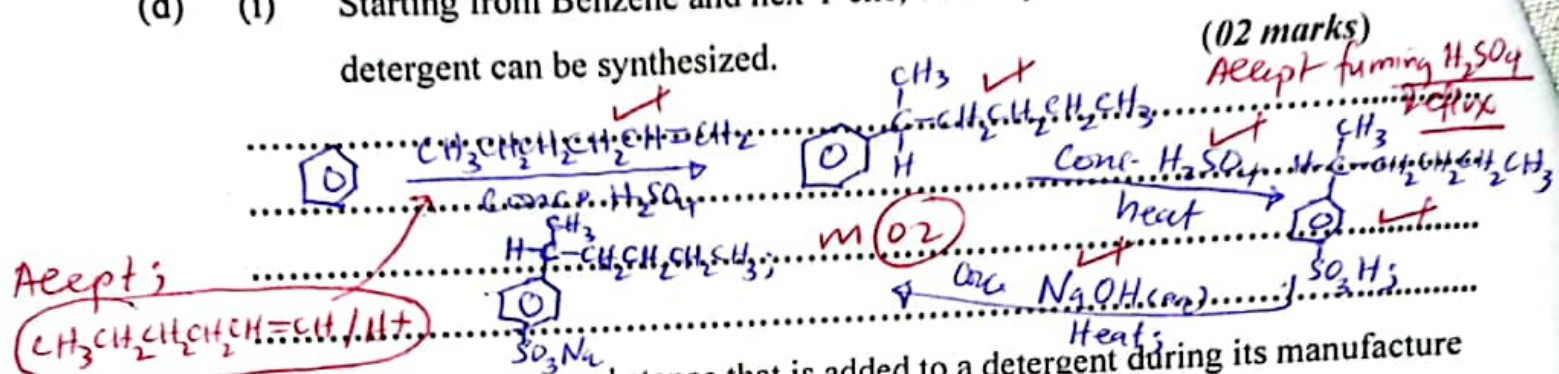
Accept a general Eqn; (red)

$$\begin{matrix} CH_2-O\overset{O}{\overset{||}{C}}-C_{17}H_{35} \\ CH-O\overset{O}{\overset{||}{C}}-C_{17}H_{35} \\ CH_2-\overset{O}{\overset{||}{C}}-C_{17}H_{35} \end{matrix} + 3NaOH_{(aq)} \overset{Heat;}{\longrightarrow} \begin{matrix} CH_2OH \\ CHOH_{(g)} \\ CH_2OH; \end{matrix} + 3C_{17}H_{35}COONa_{(s?)}.$$

Accept Ⓡ   Accept Ⓡ

(ii) Using an equation show what happens when an aluminium object is left to stand in a hot soapy solution for a long time. ✓✗ **(1½ marks)**

$$2RCOO^-_{(aq)} + 8H_2O_{(l)} + 2Al_{(s)} \longrightarrow 2RCOOH_{(aq)} + 2Al(OH)_4^-_{(aq)} + 3H_2(g).$$

OR $$2Al_{(s)} + 2OH^-_{(aq)} + 6H_2O_{(l)} \longrightarrow 2Al(OH)_4^-_{(aq)} + 3H_2(g)$$ ✓✗

deduct ½ Mark If the states is missing;

Accept any of the above;

13

(d) **(i)** Starting from Benzene and hex-1-ene, show by use of equations how a detergent can be synthesized. *(02 marks)*

Accept fuming H_2SO_4 Reflux

$CH_3CH_2CH_2CH_2CH=CH_2$

C_6H_5 $CH_2CH_2CH_2CH_3$

Conc. H_2SO_4, heat

Conc. $NaOH_{(aq)}$, Heat

SO_3Na

Accept;
$CH_3CH_2CH_2CH_2CH=CH_2 / H^+$

(ii) Name any **one** substance that is added to a detergent during its manufacture and its role. *(01 mark)*

Fragrance $\equiv$ to provide a pleasant scent;

Optical Brightener $\equiv$ to absorb U.V light;

Builders [sodium tripoly phosphate] $\equiv$ Enhance cleaning power;

Surfactants $\equiv$ Reduce surface tension of water;

(Accept any one of the above)

END