JwOgwang MARKS GUIDE

Name: ..... Sign: .....

P525/1
CHEMISTRY
(Theory)
Paper 1
July 2024

Uganda Advanced Certificate of Education

S.5 E.O.T CHEMISTRY

Paper 1

2hours 45minutes

Instructions to Candidates:

Answer **ALL** Questions in **Section A** and any **Six** Questions in **Section B. All Questions Must Be Answered** in the spaces provided.

SECTION A (46 Marks)

1. a. $^{239}_{94}Pu + {}^{4}_{2}He \rightarrow {}^{239}_{96}Cm + 2{}^{1}_{0}n$ ✓ [01 mark]

   b. $^{250}_{98}Cf + {}^{11}_{5}B \rightarrow {}^{257}_{103}Lw + 4{}^{1}_{0}n$ ✓ [01 mark]

   c. $^{214}_{83}Bi \rightarrow {}^{206}_{82}Pb + 3{}^{0}_{-1}e + {}^{4}_{2}He$ ✓ [01 mark] 03

   d. 5.00g of thorium was left to decay. Calculate the mass of thorium that remained after 2.500×10^{10} years. (*the half-life of thorium is* 1.400×10^{10}) [03 marks]

$t_{\frac{1}{2}} = \frac{0.693}{\lambda}$ ✓h ∴ Using $2.303 \log \frac{N_o}{N_t} = \lambda t$ ✓h

$\lambda = \frac{0.693}{1.4 \times 10^{10}}$ ✓h $2.303 \log \frac{5}{N_t} = 4.95 \times 10^{-11} \times 2.5 \times 10^{10}$ ✓h

$= 4.95 \times 10^{-11}$ year^{-1} ✓h $N_t = 1.45$g. ✓h 03

deduct ½ if a candidate commit to wrong unit.

06

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

a. a solution of potassium carbonate is added to aqueous aluminium nitrate.

[02½ marks]

observations:

Bubbles of a colourless gas given off and a white precipitate formed. ✓½ ✓½

Award ½ for missing / wrong state.

02½

equation:

$2Al^{3+}_{(aq)} + 3CO_3^{2-}_{(aq)} + 3H_2O_{(l)} \longrightarrow 2Al(OH)_{3(s)} + 3CO_{2(g)}$ ✓½ ✓½

or $2Al(H_2O)_6^{3+}_{(aq)} + 3CO_3^{2-}_{(aq)} \longrightarrow 2Al(H_2O)_3(OH)_{3(s)} + 3CO_{2(g)} + 3H_2O_{(l)}$

b. a mixture of acidified potassium manganate(VII) is added to hot ethane-1,2-dioic acid. [02½ marks]

① equations must have correct state symbols

② Eqns must be balanced.

observations:

Purple solution turns colourless and bubbles of colourless gas given off. ✓½ ✓½

02½

equation:

$2MnO_4^-_{(aq)} + 16H^+_{(aq)} + 5C_2O_4^{2-}_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 8H_2O_{(l)} + 10CO_{2(g)}$ ✓½ ✓½

05

Accept: $2MnO_4^-_{(aq)} + 6H^+_{(aq)} + 5H_2C_2O_4{}_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 10CO_2 + 8H_2O_{(l)}$

3. A hydrocarbon Q, with molecular formula C_xH_y reacts with oxygen according to the following equation.

$$C_xH_y + \frac{4x+y}{4}O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

When 20cm³ of Q was exploded in 200cm³ of an excess amount of oxygen, it burnt completely with a sooty flame. The volume of the residual gas after cooling to room temperature was 160cm³. When aqueous potassium hydroxide was added, the gas that finally remained was 30cm³.

Volume of CO_2 that reacted $= (160 - 20) = 140cm^3$ ✓h

a. Determine the molecular formula of Q. [02½ marks]

Volume of CO_2 formed = x · Volume of C_xH_y used.

$$\frac{20x}{20} = \frac{140}{20}$$

$x = 7$ ✓h

Volume of Oxygen used $= (200 - 20) = 180cm^3$ ✓h 02½

$$\frac{20(x + \frac{y}{4})}{20} = \frac{180}{20}$$

$$\frac{4x + y}{4} = 9$$

$4x + y = 36$

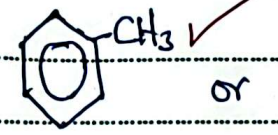
$4(7) + y = 36$

$y = 36 - 28 = 8$ ✓h

∴ Molecular formula of Q = C_7H_8 ✓h

b. When Q was treated with bromine in the presence of anhydrous iron(III) chloride, the bromine was decolorized.

i. Identify Q. [01 mark]

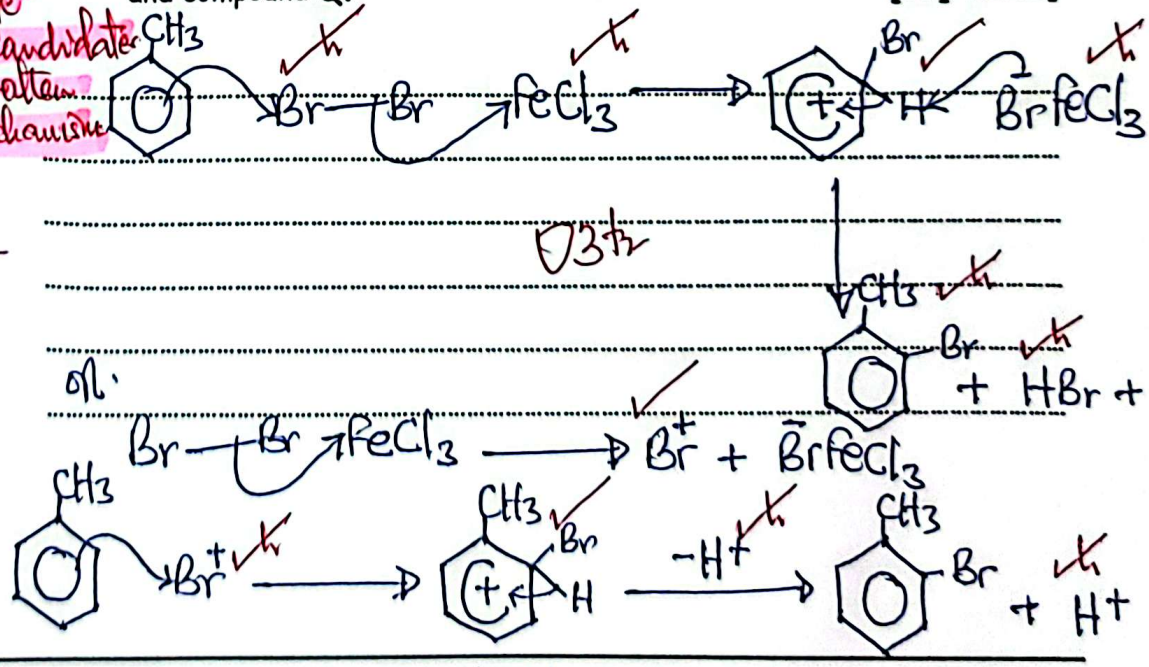


or Methylbenzene. or $C_6H_5CH_3$

ii. Write the mechanism for the reaction that took place between bromine and compound Q. [03½ marks]

Deny complete marks for Candidates who have written Eqns & Mechanism

06



OR.

$H^+ + BrFeCl_3 \longrightarrow HBr + FeCl_3$.

4. The energy changes that takes place during the formation of barium chloride are shown in the table below:

Process:			ΔH^{θ} /Kj mol^{-1}
Ba(s)	A →	Ba(g)	+176.00
Ba(g)	B →	$Ba^{2+}(g)$	+1480.00
$Cl_2(g)$	C →	2Cl(g)	+242.00
Cl(g) + e-	D →	$Cl^-(g)$	-364.00
$Ba^{2+}(g) + 2Cl^-(g)$	E →	$BaCl_2(s)$	-2018.00

a. Name the energy changes for reaction processes: [02½ marks]

A: Atomization energy. ✓½

B: Ionization energy. ✓½

C: Bond dissociation energy. ✓½

D: Electron Affinity. ✓½ 02½

E: Ignore Enthalpy of formation/ ✓½

Accept: Lattice energy ✓½

b. Calculate the standard enthalpy of formation of barium chloride. [02½marks]

$Ba(s) + Cl_2(g) \xrightarrow{\Delta Hf.} BaCl_2(s)$. ✓½ ✓½

$\Delta Hf = \Delta H_a + B.D + IE + EA + H_L$

$= 176 + 242 + 1480 + 242 + (-340 \times 2)$.

$= +1458\ kJmol^{-1}$. ✓½ $+ -2018$ 02½

05

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

-deduct ½ for missing / wrong state symbols

a. Aluminium oxide. [01½ marks]

$Al_2O_{3(s)} + 2OH^-_{(aq)} + 3H_2O_{(l)} \longrightarrow 2Al(OH)_4^-{}_{(aq)}$ ✓th

OR $Al_2O_{3(s)} + 6OH^-_{(aq)} + 3H_2O_{(l)} \longrightarrow 2Al(OH)_6^{3-}{}_{(aq)}$.

b. Beryllium oxide. [01½ marks]

$BeO_{(s)} + 2OH^-_{(aq)} + H_2O_{(l)} \longrightarrow Be(OH)_4^{2-}{}_{(aq)}$ ✓th

0½ OR $BeO_{(s)} + 2OH^-_{(aq)} \longrightarrow BeO_2^{2-}{}_{(aq)} + H_2O_{(l)}$.

c. Tin(II) oxide. [01½ marks]

$SnO_{(s)} + 2OH^-_{(aq)} + H_2O_{(l)} \longrightarrow Sn(OH)_4^{2-}{}_{(aq)}$ ✓th

OR $SnO_{(s)} + 2OH^-_{(aq)} \longrightarrow SnO_2^{2-}{}_{(aq)} + H_2O_{(l)}$.

6. a. Define the term freezing point constant of a substance. [01½ marks]

is the depression in freezing point when one mole of ✓th ✓th
anon-volatile solute is dissolved in 1000g of solvent ✓th

b. A solution containing 1.54g of naphthalene, $C_{10}H_8$ in 18.0g of camphor freezes at 148.3°C. Calculate the freezing point constant of camphor. (K_f for camphor is 175°C) [03 marks]

18.0g of camphor dissolved 1.54g of naphthalene.

∴ 1000g of camphor will dissolve $= \left(\frac{1000 \times 1.54}{18}\right) = 85.56g$. ✓th ✓th

(175 - 148.3)

85.56g of Naphthalene depressed freezing point by 26.7°C

0½ 128g of Naphthalene will depress freezing point by.

$= \left(\frac{128 \times 26.7}{85.56}\right)°C.$

All working should be from 1st principles

$= 39.94°C.$ ✓th

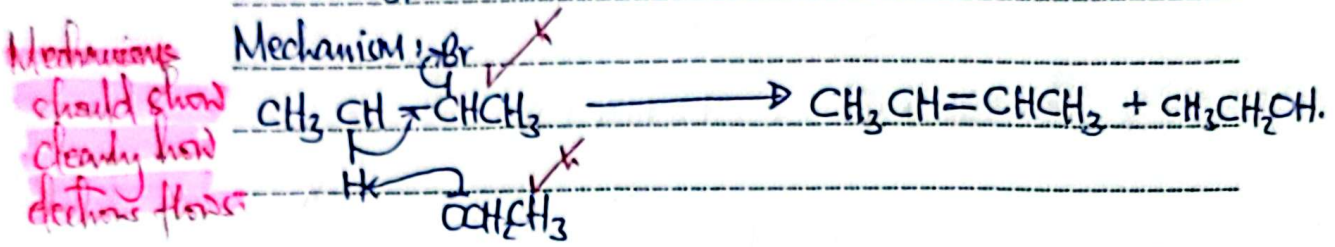
Molar Mass of Naphthalene $= (12 \times 10 + 8) = 128$ ✓th

7. 2-bromobutane was treated with sodium ethoxide in ethanol and the mixture heated to form compound T.

a. Write the equation and suggest a mechanism for the reaction between 2-bromobutane and ethoxide ion. [02½ marks]

$$CH_3CH_2\underset{Br}{C}HCH_3 \xrightarrow[Heat]{CH_3CH_2\bar{O}\,/CH_3CH_2OH} CH_3CH{=}CHCH_3 + Br^-$$

Mechanism:



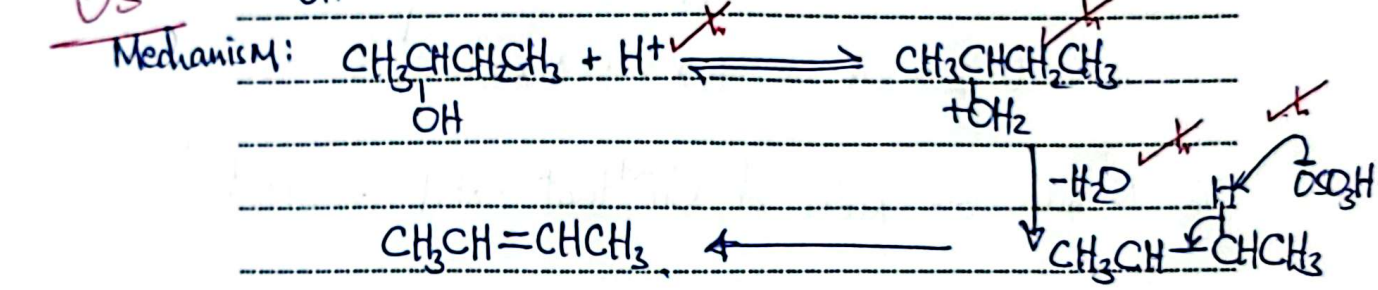
Mechanisms should show clearly how electrons flow

b. The compound T formed in(a) can be synthesized from an alcohol. Write the equation and include a mechanism for the reaction leading to the formation of T from an alcohol. [02½ marks]

$$CH_3\underset{OH}{C}HCH_2CH_3 \xrightarrow[Heat]{Conc.\ H_2SO_4} CH_3CH{=}CHCH_3 + H_2O$$

DS

Mechanism:



8. 0.89g of a copper ore was leached with dilute sulphuric acid and the resultant solution diluted to 250cm^3. To 30cm^3 of this solution was added 10% potassium iodide solution. The liberated iodine required 23.5cm^3 of 0.05M sodium thiosulphate solution for complete reaction. Calculate the percentage of copper in the ore. The reactions taking place are: - [04½ marks]

$$2Cu^{2+}(aq) + 4I^- \rightarrow Cu_2I_2(s) + I_2(aq)$$

$$I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$$

1000cm^3 of $S_2O_3^{2-}$ solution contains 0.05 moles.

∴ 23.50cm^3 of $S_2O_3^{2-}$ solution will contains $= \left(\frac{23.50 \times 0.05}{1000}\right)$ moles.

$= 1.175 \times 10^{-3}$ moles.

Mole ratio $S_2O_3^{2-}(aq)$: $I_2(aq)$.

2 : 1.

$\therefore 1.175 \times 10^{-3} : \frac{1 \times 1.175 \times 10^{-3}}{2}$.

Number of moles of I_2 that rxted $= 0.5875 \times 10^{-3}$ moles.

Mole ratio $I_2(aq)$: Cu^{2+}

1 : 2.

$\therefore 0.5875 \times 10^{-3} : 2 \times 0.5875 \times 10^{-3}$.

$\therefore$ Number of moles of Cu^{2+} that rxted $= 1.175 \times 10^{-3}$ moles.

∴ $30cm^3$ of solution contains $2 \times 0.5875 \times 10^{-3}$ moles of Cu^{2+}

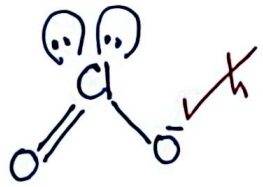
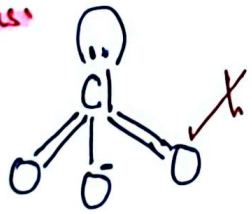
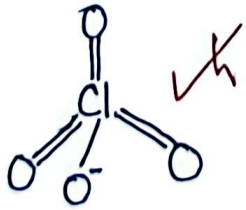
∴ $1000cm^3$ of solution will contain $= \left(\frac{1000}{30} \times 2 \times 0.5875 \times 10^{-3}\right)$

Number of Moles of $Cu^{2+} = 0.009792$ Moles

Mass of Pure copper $= 63.5 \times 0.009792 = 0.622g$.

04½ Percentage of copper in ore $= \left(\frac{0.622}{0.89} \times 100\right) = 69.9\%$.

9. Draw the structure and name the shape of the following anions. In each case, state the oxidation state of the chlorine atom. [04½ marks]

Anion	Structure	Shape	Oxidation state of chlorine
ClO_2^-		V-shaped or bent.	+3
ClO_3^-		Trigonal pyramidal	+5
ClO_4^-		Tetrahedral	+7

- Symbols have to be correct.
- Structure should be correct.
- Bonds fairly near atoms.

04½

SECTION B (54 Marks)

Attempt ANY SIX Questions from this Section.
Additional Questions Shall not be marked.

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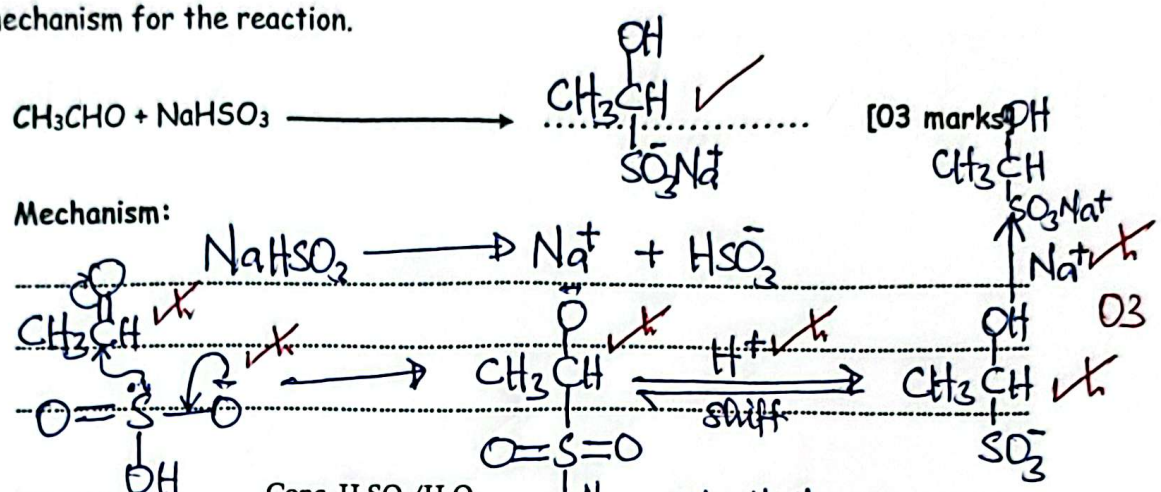
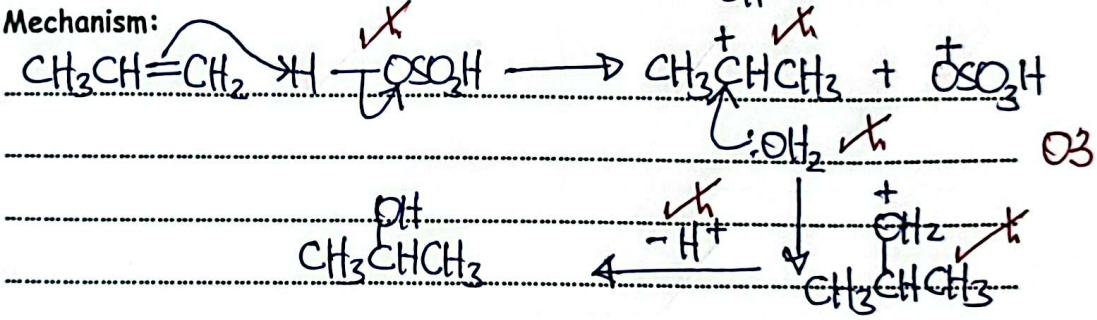
10. Complete the following equations of reactions and in each case outline a mechanism for the reaction.

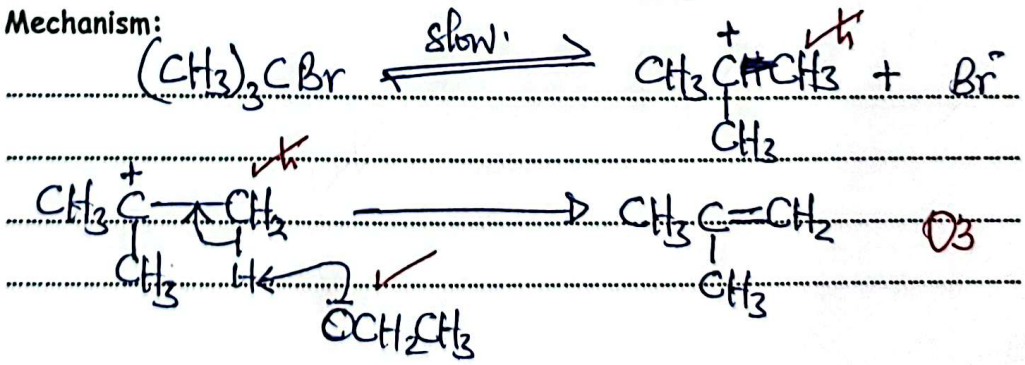
a) $CH_3CHO + NaHSO_3 \longrightarrow$ ..... [03 marks]



b) $CH_3CH{=}CH_2 \xrightarrow[\text{Warm}]{\text{Conc. } H_2SO_4/H_2O}$ ..... [03 marks]



c) $(CH_3)_3CBr \xrightarrow[\text{Heat}]{C_2H_5O^-Na^+/C_2H_5OH}$ ..... [03 marks]



09

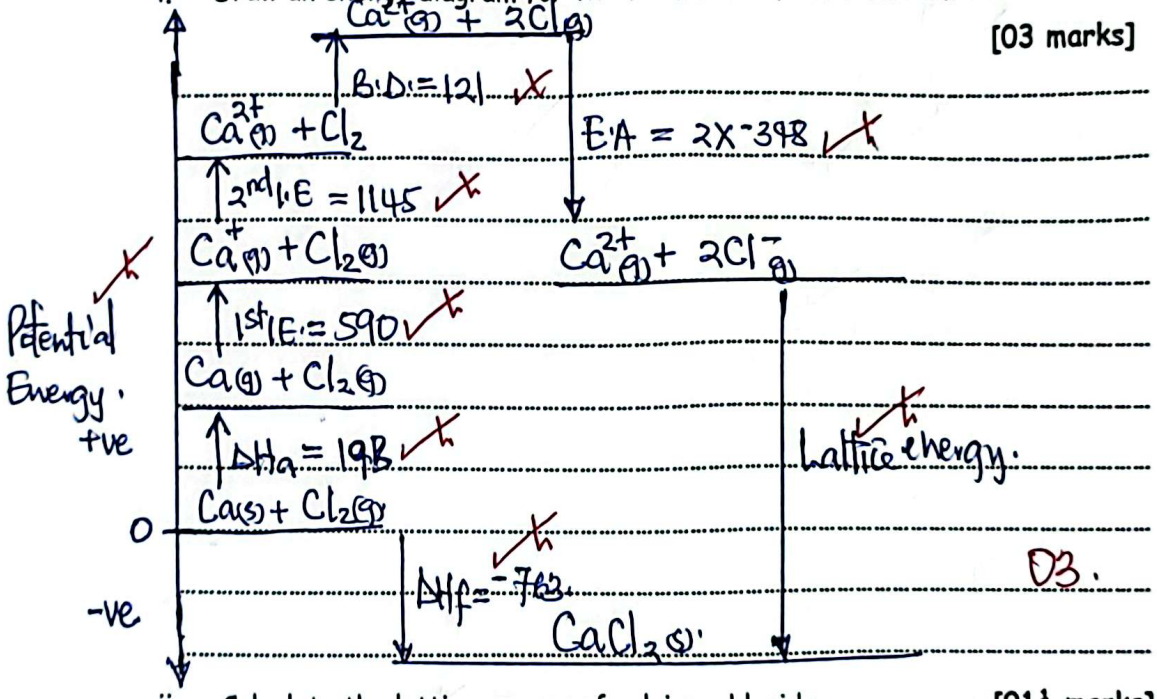
11. a. Define the term Standard enthalpy of formation. [01 mark]

is the enthalpy change when one mole of a substance is formed from its elements in their standard states under standard conditions. ✓ 01

b. Some thermochemical data for calcium, calcium chloride and chlorine are given below:

enthalpy of formation of calcium chloride	-763 $kJmol^{-1}$.
Enthalpy of atomization of chloride.	+121 $kJmol^{-1}$.
Enthalpy of atomization of calcium	+193 $kJmol^{-1}$.
First ionization energy of calcium	+590 $kJmol^{-1}$.
Second ionization energy of calcium.	+1145 $kJmol^{-1}$.
Electron affinity for chlorine.	-348 $kJmol^{-1}$.

i. Draw an energy diagram for the formation of solid calcium chloride. [03 marks]



03.

ii. Calculate the lattice energy of calcium chloride. [01½ marks]

Using Hess's law ✓h

$\Delta H_f = \Delta H_a + 1^{st}IE + 2^{nd}IE + B.D + EA + U_L$

$-763 = 193 + 590 + 1145 + 121 + 2X-348 + U_L$.

 01½

$-763 = 1353 + U_L$ ✓h

∴ Lattice energy of $CaCl_2 = -2116\ kJ\,mol^{-1}$ ✓h

c. Calculate the enthalpy of solution of calcium chloride. [02½ marks]

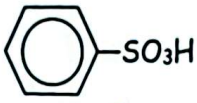
(enthalpy

d. Comment on the solubility of calcium chloride. [01 mark]

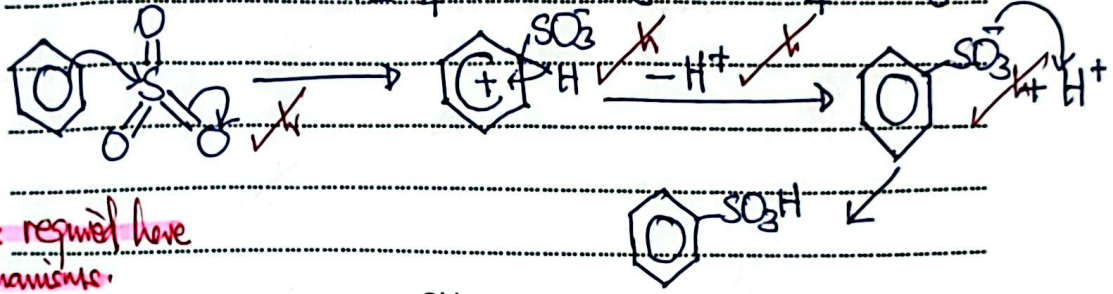
Calcium chloride is soluble since its enthalpy of solution is negative. 01

09

12. Write a mechanism to show how each of the following conversion can be effected.

a)  to  [03 marks]

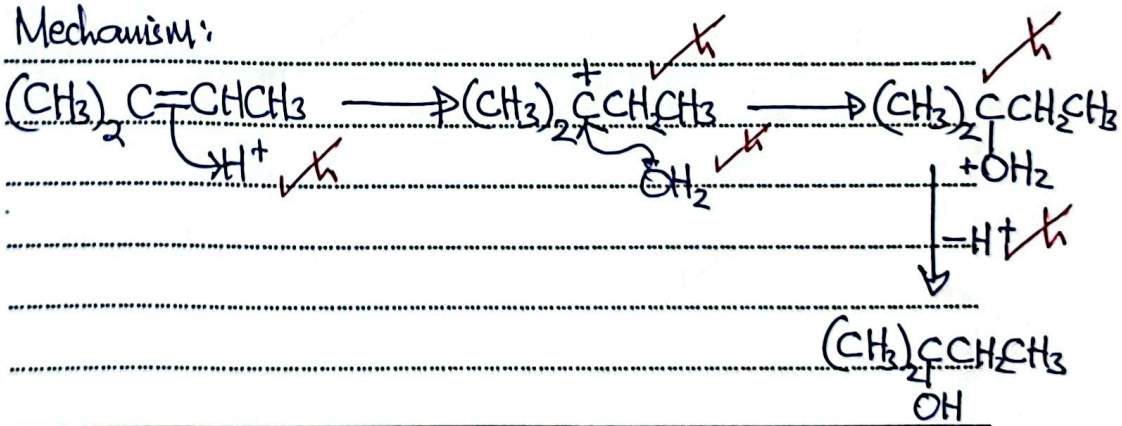
Mechanism: $2H_2SO_4 \rightleftharpoons SO_3 + HSO_4^- + H_3O^+$



No equations required here except mechanisms.

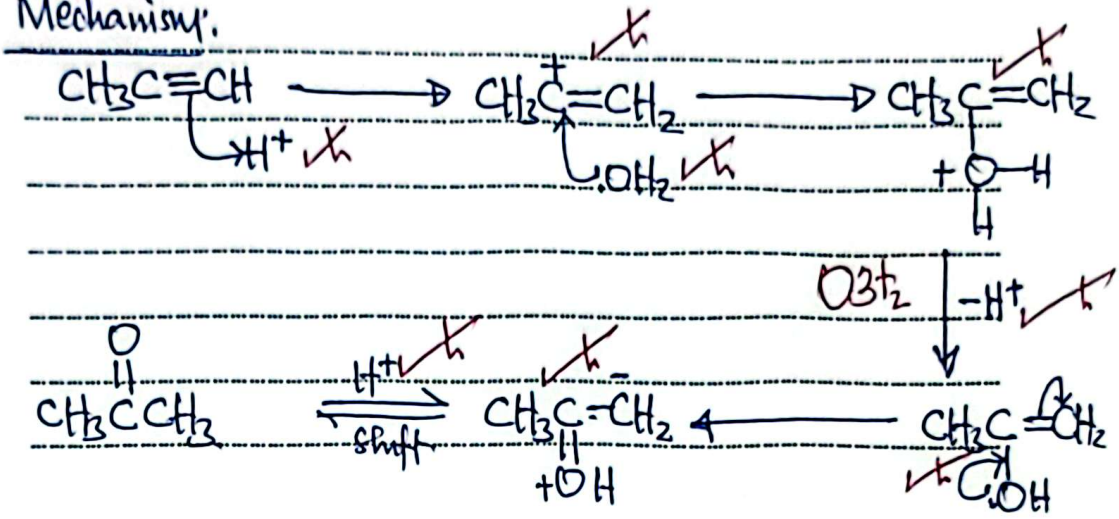
b) $(CH_3)_2C{=}CHCH_3$ to $(CH_3)_2C(OH)CH_2CH_3$ [02½ marks]

Mechanism:



c) $CH_3C{\equiv}CH$ to CH_3COCH_3 [03½ marks]

Mechanism:



09

13. Beryllium and magnesium are elements in group (II) of the Periodic Table.

a) Explain the following: $Be(4) = 1s^2\,2s^2$

$Mg(12) = 1s^2\,2s^2\,2p^6\,3s^2$

i. The first ionization energy of beryllium is higher than that of magnesium. [02 marks]

Beryllium has a smaller atomic radius and a higher effective nuclear charge than Magnesium so its outermost electron in beryllium experience stronger nuclear attraction leading to a higher first ionization energy than Magnesium.

02.

ii. The polarizing power of magnesium ions is lower than that of beryllium ions. [01 mark]

Beryllium has a smaller ionic radius and higher charge density than Magnesium or Magnesium ion has a larger ionic radius and smaller charge density.

01.

b) Beryllium reacts with aqueous sodium hydroxide solution. Write equation for the reaction. [01½ marks]

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

01½

OR.

$Be_{(s)} + 2OH^-_{(aq)} \longrightarrow BeO_2^{2-}{}_{(aq)} + H_2O_{(l)}$.

Award marks for only one equation.

c) State the conditions under which beryllium oxide and magnesium oxide reacts with the following substances and where applicable, write equation(s) for the reaction(s).

i. Water. [02 marks]

heated

Beryllium does not react with water. Magnesium rxts with steam to form Magnesium oxide and hydrogen gas.

04½ $Mg_{(s)} + H_2O_{(g)} \longrightarrow MgO_{(s)} + H_{2(g)}$

with cold water slowly to form Magnesium hydroxide.

ii. Sodium hydroxide. $Mg_{(s)} + 2H_2O_{(l)} \longrightarrow Mg(OH)_2 + H_{2(g)}$. [02½ marks]

Beryllium oxide rxts with hot concentrated Sodium hydroxide to form beryla-te with sodium hydroxide.

$BeO_{(s)} + 2OH^-_{(aq)} + 2H_2O_{(l)} \longrightarrow Be(OH)_4^{2-}{}_{(aq)}$.

14. Potassium manganate(VII) is not used a primary standard in volumetric analysis and has to be standardized.

a. Explain why potassium manganate(VII) is not used as a primary standard. [01 mark]

Beg its always contaminated with its oxide Manganese (IV) oxide.

b. Explain why hydrochloric acid is not usually used to acidify solution of potassium manganate(VII) during volumetric analysis. [01 mark]

Beg Potassium Manganate (VII) oxidises chloride ions in hydrochloric acid to molecular chlorine which is also an oxidising agent.

02

$2KMnO_{4(s)} + 16HCl_{(aq)} \longrightarrow 2KCl_{(aq)} + 2MnCl_{2(aq)} + 8H_2O_{(l)} + 5Cl_{2(g)}$

OR. $2MnO_4^-{}_{(aq)} + 10Cl^-_{(aq)} + 16H^+_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 5Cl_{2(g)} + 8H_2O_{(l)}$

Alt: $C_2O_4^{2-}(aq) \longrightarrow 2CO_2(g) + 2e^-$

c. Acidified potassium manganate(VII) reacts with ethane-1,2-dioic acid.

i. the half -reaction equations for the reaction. [02 mark]

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$ ✓

02 $H_2C_2O_4(aq) \longrightarrow 2H^+(aq) + 2CO_2(g) + 2e^-$ ✓

Alt: $C_2O_4^{2-}(aq) \longrightarrow 2CO_2(g) + 2e^-$

① Award ½ for missing state

① Award zero for unbalanced eqn.

ii. the overall equation for the reaction. [01½ mark]

$2MnO_4^-(aq) + 6H^+(aq) + 5H_2C_2O_4 \longrightarrow 2Mn^{2+}(aq) + 8H_2O(l) + 10CO_2(g)$.

d. 20.00cm³ of a 0.01M manganate(VII) ion solution required exactly 16.55cm³ of a solution containing 5.10g per liter of an ethanedioate, $(COO^-X^+)_2.2H_2O$. Determine the atomic mass of element X. [03½ marks]

$1000cm^3$ of MnO_4^- soln contains 0.01 moles. ✓

$\therefore 20.0cm^3$ of MnO_4^- will contains $= \left(\frac{20 \times 0.01}{1000}\right) = 2.0 \times 10^{-4}$ moles.

Mole ratio $MnO_4^-(aq) : C_2O_4^{2-}(aq)$

$2 : 5$

$2 \times 10^{-4} : \frac{5 \times 2.0 \times 10^{-4}}{2}$ ✓

03½

Number of Moles of $C_2O_4^{2-} = 5.0 \times 10^{-4}$ Moles. ✓

$\Rightarrow 16.55cm^3$ of $C_2O_4^{2-}$ contains 5.0×10^{-4} moles ✓

$\therefore 1000cm^3$ of $C_2O_4^{2-}$ will contain $= \left(\frac{1000 \times 5.0 \times 10^{-4}}{16.55}\right)$ ✓

09: Molar Concentration of $C_2O_4^{2-} = 0.0302$ Mol dm^{-3}.

0.0302 Mol dm^{-3} of $C_2O_4^{2-}$ contains 5.10g

$\therefore$ 1mol of $C_2O_4^{2-}$ will contains $= \left(\frac{1 \times 5.10}{0.0302}\right) = 168.9$

$\therefore (COOX)_2.2H_2O = 168.9$ ✓

$76 + 2X + 36 = 168.9$ ✓

$124 + 2X = 168.9$

$\frac{2X}{2} = \frac{46.9}{2}$ ✓

$X = 23$ ✓

15. During the extraction of aluminum from bauxite, $Al_2O_3.2H_2O$, the ore is first purified.

a) Name two major impurities in the ore. [01 mark]

Silicon (IV) oxide / silicon dioxide ✓

Iron (III) oxide ✓

Reject IV or III or (iv) or (iii).

Reject: Titanium oxide – Minor Impurity.

b) Write equations to show how the ore is purified. [06 marks]

$Al_2O_3.2H_2O(s) \longrightarrow Al_2O_3(s) + 2H_2O(l)$ ✓

$Al_2O_3(s) + 2OH^-(aq) + 3H_2O(l) \longrightarrow 2Al(OH)_4^-(aq)$ ✓✓

$2Al(OH)_4^-(aq) + CO_2(g) \longrightarrow 2Al(OH)_3(s) + CO_3^{2-}(aq) + H_2O(l)$

OR $Al(OH)_4^-(aq) + Al(OH)_3(s) \longrightarrow 2Al(OH)_3(s) + OH^-(aq)$.

$SiO_2(s) + 2OH^-(aq) \longrightarrow SiO_3^{2-}(aq) + H_2O(l)$.

$2Al(OH)_3(s) \longrightarrow Al_2O_3(s) + 3H_2O(l)$ ✓✓

09 06

c) Describe briefly how aluminium can be obtained after the ore has been purified. [02 marks]

Cryolite is added to pure aluminium oxide and the mixture is heated to melt. The Molten mixture is electrolyzed using graphite and a low voltage to obtain pure aluminium. 02.

Rxn at cathode:

$Al^{3+}(aq) + 3e^- \longrightarrow Al(s)$.

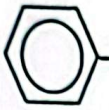
16. Name a reagent that can be used to distinguish between each of the following pairs of compounds/ ions. In each case state what would be observed if each member of the pair is treated with the reagent you have named.

a) $CH_3CH_2C\equiv CH$ and $CH_3CH_2CH=CH_2$ [03 marks]

i. Reagent:
Ammoniacal silver nitrate solution ✓ or Tollen's reagent (ammoniacal copper(I) chloride)

ii. Observation:
$CH_3CH_2C\equiv CH$ forms a white ✓ precipitate or red precipitate.
$CH_3CH_2CH=CH_2$ - No observable ✓ change. 03

$CH_3CH_2C\equiv CH + CuCl + NH_3(aq) \longrightarrow CH_3CH_2C\equiv CCu(s) + NH_4Cl$.

b)  and $CH_3CH_2CH_2Cl$. [03 marks]

i. Reagent:

Conditions for the rxn taking place.

Hot aqueous sodium hydroxide, dilute nitric acid followed by silver nitrate solution.

Observation:

 – No observable change.

$CH_3CH_2CH_2Cl$ – White precipitate formed.

c) Ca^{2+} and Ba^{2+} [03 marks]

ii. Reagent:

Potassium chromate(VI) solution and ethanoic acid solu

iii. Observation:

Ba^{2+}: Yellow precipitate insoluble in ethanoic acid.

Ca^{2+}: Yellow precipitate soluble in ethanoic acid. 09

17. a. A compound W contains 37.3% manganese, 19.1% nitrogen, the rest being oxygen. Calculate the empirical formula of compound W. [02½ marks]
[Mn=54.9, N=14, O=16]

Element	Mn	N	O
% Mass	37.3	19.1	(100 − 56.4) = 43.6
Moles	$\frac{37.3}{54.9}$	$\frac{19.1}{14}$	$\frac{43.6}{16}$
Ratio	$\frac{0.6794}{0.6794}$	$\frac{1.3643}{0.6794}$	$\frac{2.725}{0.6794}$
	1	: 2	: 4

02½

Empirical formular of W = MnN_2O_4

(K_f for water $= 1.86\ °C\ mol^{-1} kg$)

b. 10.0g of compound W in 1000g of water lowered the freezing point of water by 0.127°C. Determine the molecular formula of W. [02 marks]

0.127°C is the depression in freezing point caused by 10g of W

∴ 1.86°C will be depression in freezing point caused by $\left(\frac{1.86 \times 10}{0.127}\right)$ g of W.

$= 146.5$ g.

Molecular formula $= (MnN_2O_4)n = 146.5$

$\frac{146.9n}{146.9} = \frac{146.5}{146.9}$ 02

$n = 1$

$= MnN_2O_4$

c. When a few drops of concentrated nitric acid were added to a solution of W, followed by a little lead(IV) oxide and the mixture boiled, a purple coloured solution was formed. Write:

i. formula and name of W. [01 mark]

formula:

$Mn(NO_2)_2$

Name:

Manganese (II) Nitrite 01

ii. equation for the reaction leading to the formation of the purple coloured solution. [01½ marks]

$2Mn^{2+}_{(aq)} + 5PbO_{2(s)} + 4H^{+}_{(aq)} \longrightarrow 2MnO_4^{-}{}_{(aq)} + 5Pb^{2+}_{(aq)} + 2H_2O$ 01½

e. A few drops of aqueous sodium carbonate was added to a solution of W.

i. State was observed. [01 mark]

White precipitate formed. ✓

ii. Write an equation for the reaction that took place. [01½ marks]

$Mn^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow MnCO_{3(s)}$ ✓✓

or: $Mn^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} + 2OH^-_{(aq)} \longrightarrow MnCO_3{\cdot}Mn(OH)_{2(s)}$.

or: $Mn^{2+}_{(aq)} + Na_2CO_{3(aq)} \longrightarrow MnCO_{3(s)} + 2Na^+_{(aq)}$

END

09

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