

DAR-ES-SALAAM REGION
FORM VI MOCK EXAM
CHEMISTRY 3A
MARKING SCHEME.

Part I

Table of results.

Experiment	Pilot	1	2	3
Final volume (cm ³)	20.50	20.20	20.00	20.10
Initial volume (cm ³)	0.00	0.00	0.00	0.00
Volume used (cm ³)	20.50	20.20	20.00	20.10

Filling the table = 01 Mark
 Decimal places = 01 Mark
 Accurate volume = 01 Mark.
 Total = (03) Marks

$$\begin{aligned}
 \text{Average volume used} &= \frac{T_1 + T_2 + T_3}{3} \\
 &= \frac{(20.20 + 20.00 + 20.10) \text{ cm}^3}{3} \\
 &= 20.10 \text{ cm}^3.
 \end{aligned}$$

01 Mark

Summary

20 cm³ of a solution A₁ required 20.10 cm³ of a solution A₂ for complete reaction. 01 Mark

Part II

Table of results.

Experiment	Pilot	1	2	3
Final volume (cm ³)	23.90	23.60	23.60	23.70
Initial volume (cm ³)	0.00	0.00	0.00	0.00
Volume used (cm ³)	23.90	23.60	23.60	23.70

Filling the table = (01)
 Decimal places = (01)
 Accurate volume = (01)
 Total = (03)

$$\text{Average volume used} = \frac{V_1 + V_2 + V_3}{3}$$

$$= \frac{(23.60 + 23.60 + 23.70) \text{ cm}^3}{3}$$

$$= \frac{70.9}{3}$$

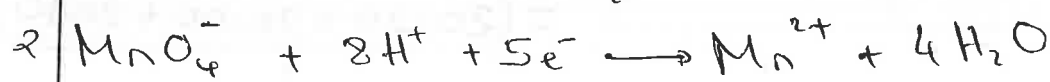
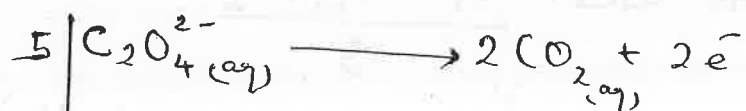
$$= \underline{23.63 \text{ cm}^3}$$

0/Mark

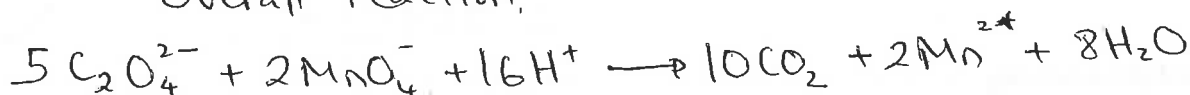
a) Calculate the;

1) Molarity of potassium permanganate.

Considering a balanced chemical equation.



Overall reaction.



$$n_o = 5$$

$$n_p = 2.$$

Finding the molarity of sodium oxalate;

$$\text{Conc. in g/dm}^3 = \frac{m}{V} = \frac{3.35}{0.5 \text{ dm}^3} = 6.7 \text{ g/dm}^3 \quad (0.5)$$

$$\text{Then, Molarity} = \frac{\text{Conc. in g/dm}^3}{\text{Molar mass}} = \frac{6.7 \text{ g/dm}^3}{134 \text{ g/mol}} \quad (0.5)$$

$$= \underline{0.05 \text{ M}}$$

$$\text{From; } \frac{M_p V_p}{n_p} = \frac{M_o V_o}{n_o}$$

$$M_p = \frac{M_o V_o n_p}{V_p n_o}$$

(0.5)

$$M_p = \frac{0.05M \times 20 \text{ cm}^3 \times 2}{20.10 \times 5}$$

$$M_p = 0.02M$$

(a)

∴ The molarity of potassium permanganate is 0.02M.

(i) Concentration of potassium permanganate in g/dm³.

From:

$$\text{Conc. in g/dm}^3 = \text{Molarity} \times \text{Molar mass.}$$

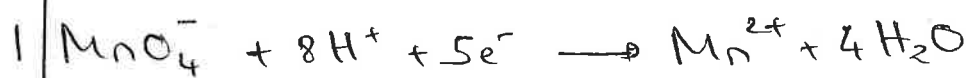
$$= 0.02M \times 158 \text{ g/mol.}$$

$$= \underline{3.16 \text{ g/dm}^3}.$$

(a)

(ii) Molarity of iron (ii) salt.

considering a balanced equation,



Overall equation,



(a)

$$n_{\text{Fe}} = 5, n_p = 1.$$

$$\text{From; } \frac{M_{\text{Fe}} V_{\text{Fe}}}{n_{\text{Fe}}} = \frac{M_p V_p}{n_p}.$$

(a)

$$M_{\text{Fe}} = \frac{M_p V_p n_{\text{Fe}}}{V_{\text{Fe}} n_p}.$$

$$M_{\text{Fe}} = \frac{0.02M \times 20.10 \text{ cm}^3 \times 5}{23.63 \text{ cm}^3}.$$

$$M_{\text{Fe}} = 0.085M.$$

(a)

∴ The molarity of iron(II) salt is 0.085M.

iv) Concentration of anhydrous iron (ii) salt in g/dm^3 .

From;

$$\begin{aligned}\text{Concentration in } \text{g/dm}^3 &= \text{Molarity} \times \text{Molar mass.} \\ &= 0.085 \text{ M} \times 284 \text{ g/mol.} \\ &= \underline{24.14 \text{ g/dm}^3}. \quad (01)\end{aligned}$$

b) Required the value of X .

Given;

$$\text{Conc. in } \text{g/dm}^3 = 33.3 \text{ g/dm}^3.$$

$$\text{Molarity} = 0.085 \text{ M}.$$

$$\text{From: Molar mass} = \frac{\text{Conc. in } \text{g/dm}^3}{\text{Molarity}}$$

$$= \frac{33.3 \text{ g/dm}^3}{0.085 \text{ M}.$$

$$= 391.76 \text{ g/mol.} \quad \text{--- (01 Mark.)}$$

Then;

$$\text{Fe}(\text{SO}_4)_2 \cdot \text{NH}_4 \cdot X \text{H}_2\text{O} = 391.76$$

$$56 + (16 + 64) \times 2 + 14 + 4 + 18x = 391.76$$

$$284 + 18x = 391.76$$

$$\frac{18x}{18} = \frac{107.76}{18}$$

$$x = 6.$$

$\therefore$ The value of X is 6.

(01)

00 1/2

2 a) Part I.

Initial temperature (T_i) = 32°C . (01)

Final temperature (T_f) = 52°C

$$\Delta T = T_f - T_i$$

$$\Delta T = 52^\circ\text{C} - 32^\circ\text{C}$$

$$\underline{\Delta T = 20^\circ\text{C}}. \quad (01)$$

Part II:

Initial temperature (T_i) = 32°C . (01)

Final temperature (T_f) = 34°C .

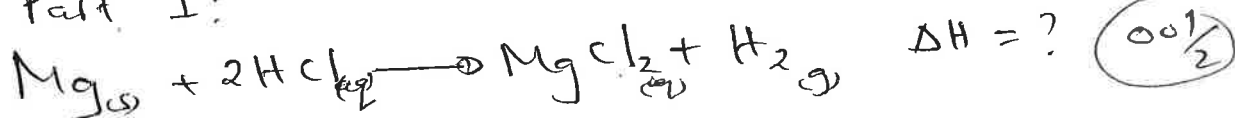
$$\Delta T = T_f - T_i$$

$$\Delta T = 34^\circ\text{C} - 32^\circ\text{C}$$

$$\underline{\Delta T = 2^\circ\text{C}}. \quad (01)$$

a) Required the heat evolved.

Part I:



From: $\Delta H = -m \times c \times \Delta T$.

$$\Delta H = -\rho V c \Delta T$$

$$\Delta H = -1\text{g/cm}^3 \times 50\text{cm}^3 \times 4.2\text{Jg}^{-1}\text{K}^{-1} \times 20^\circ\text{C}$$

$$\Delta H = -4200\text{J} \text{ or } -4.2\text{kJ}. \quad (01)$$

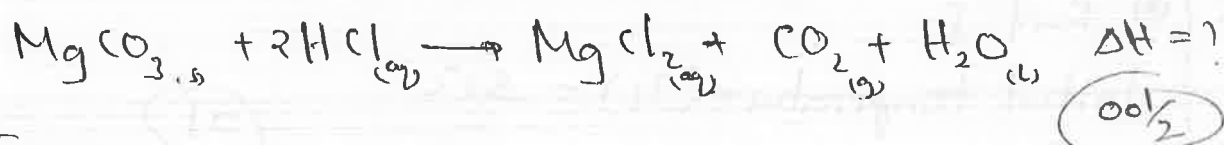
But; $0.2\text{g of Mg} \equiv -4.2\text{kJ}$

$$24\text{g of Mg} \equiv ?$$

$$-504\text{kJ/mol}. \quad (01)$$

$\therefore$ The heat evolved during the reaction in part I is -504kJ/mol .

Part II.



From; $\Delta H = -mc\Delta T$

$$\Delta H = -\rho V c \Delta T$$

$$\Delta H = -1\text{g/cm}^3 \times 50\text{cm}^3 \times 2^\circ\text{C} \times 4.2\text{J/gK}$$

$$\Delta H = -420\text{J} \text{ or } -0.42\text{kJ}$$

But;

$$1\text{g of MgCO}_3 \rightarrow -0.42\text{kJ}$$

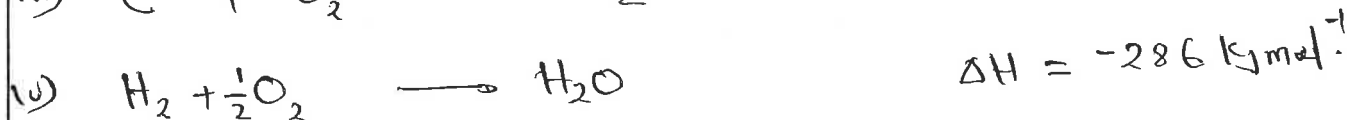
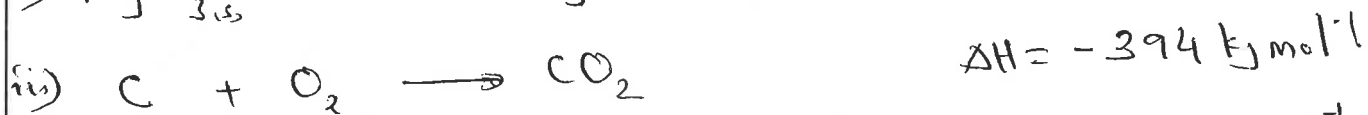
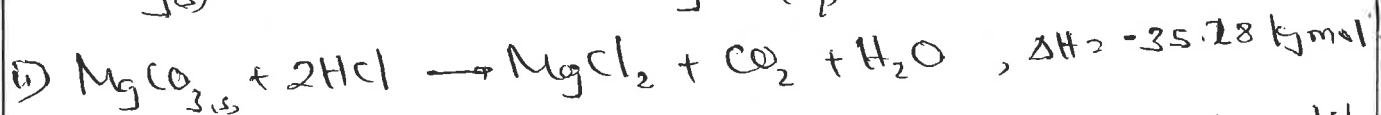
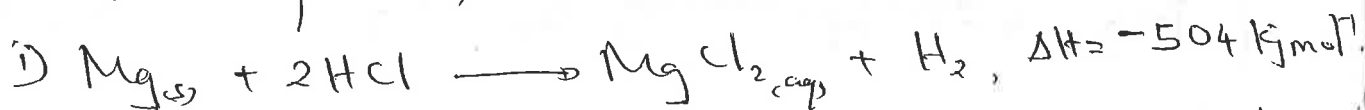
$$84\text{g (1mol) of MgCO}_3 \rightarrow ?$$

$$\Delta H = -35.28\text{ kJ/mol}$$

∴ The evolved during the reaction in part II is -35.28 kJ/mol .

b) Required the enthalpy of MgCO_3 .

Given equation;

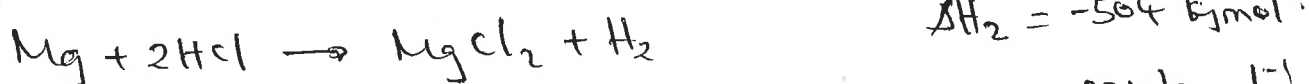
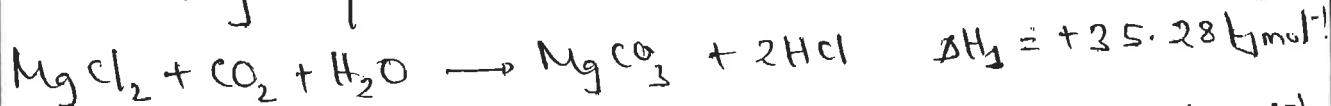


Required equation,



00½ @ = 02½ Marks

Reversing equation (iv)



$$\Delta H_f = \Delta H_1 + \Delta H_2 + \Delta H_3 + \Delta H_4$$

$$\Delta H_f = +35.28 + -504 + -394 + -286 \text{ kJ mol}^{-1}$$

$$\Delta H_f = -1148.72 \text{ kJ mol}^{-1}$$

∴ The heat of formation of MgCO_3 was $-1148.72 \text{ kJ mol}^{-1}$.

Sl. No.	Exp.	Observation	Inference.
(a)	(0 1/2)	Green-yellow colour crystalline form	Fe^{2+} , Ni^{2+} , Cr^{3+} , Cu^{2+} , Fe^{3+} CrO_4^{2-} may be present. NO_3^- , SO_4^{2-} , Cl^- , $\text{C}_2\text{O}_4^{2-}$, CrO_4^{2-} , NO_2^- , CH_3COO^- $\text{Cr}_2\text{O}_7^{2-}$ may be present.
(b)	(0 1/2)	Blue-green flame was observed Yellow sparks	Cu^{2+} may be present. Fe^{2+} , Fe^{3+} may be present.
(c)	(0 1/2)	Black/Reddish brown residue was observed.	Cu^{2+} , Fe^{2+} , Fe^{3+} may be present.
(d)	(0 1/2)	Colourless gas with irritating smell evolved, which turns moist litmus paper from blue to red and form dense white fumes with ammonia gas.	Cl^- may be present.
(e)	(0 1/2)	Dirty green precipitate insoluble in excess turns brown on exposure to air.	Fe^{2+} may be present.
f	(0 1/2)	i) Dark blue precipitate was formed.	Fe^{2+} confirmed.
	(0 1/2)	ii) Blue precipitate soluble in excess ammonia forming a deep blue solution.	Cu^{2+} confirmed.
g	(0 1/2)	White precipitate soluble was formed.	Cl^- confirmed.

Conclusion.

- i) The cations in Sample M are Fe^{2+} and Cu^{2+} . (01)
- ii) The anion in Sample M is Cl^- (01)
- iii) The molecular formula M is FeCl_2 and CuCl_2 . (01)

Total = 15 Marks

