



FWC

Grade - 12 (2020)

G.C.E A/L Examination July - 2019

Field Work Centre

Chemistry

Marking Scheme

1> 5	6> 2	11> 4	16> 4	21> 2
2> 4	7> 2	12> 5	17> 2	22> 4
3> 3	8> 3	13> 1	18> 1	23> 1
4> 1	9> 1	14> 4	19> 4	24> 3
5> 3	10> 2	15> 5	20> 3	25> 5

(25 x 2 = 50 Marks)

PART-A

Q1.

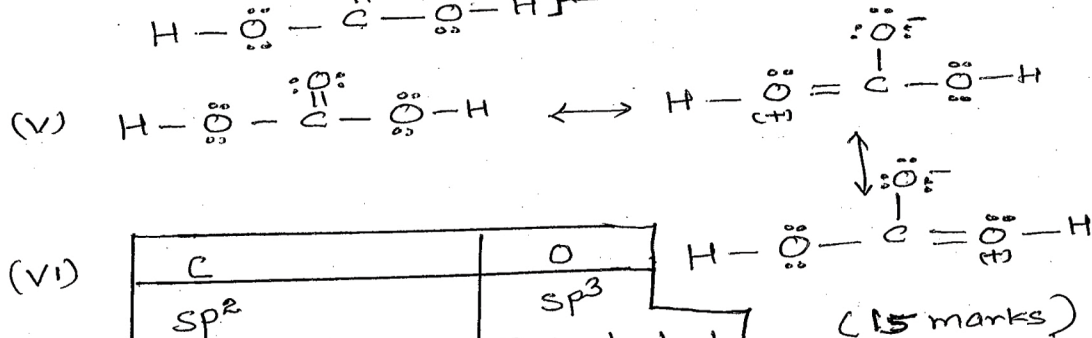
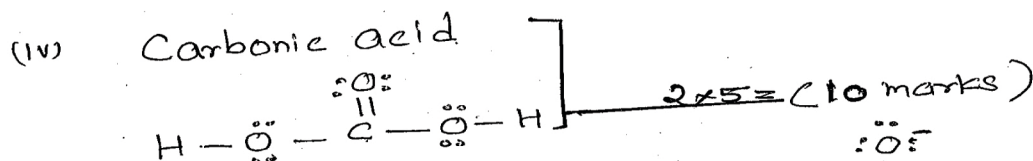
- a) (i) True (ii) False (iii) false (iv) True (v) True

[5 x 5 = 25 marks]



(ii) CO - Carbon monoxide
CO₂ - Carbon dioxide [2 x 2.5 = 05 marks]

(iii) H₂CO₃ [05 marks]



(vi)

C	O
sp ²	sp ³
Trigonal planar	Tetrahedral
Trigonal planar	Bent
+4	-2

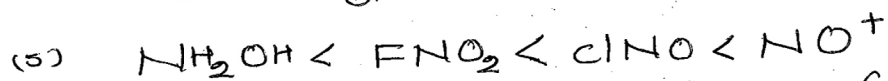
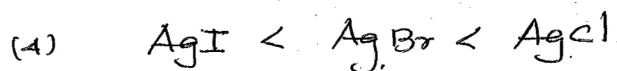
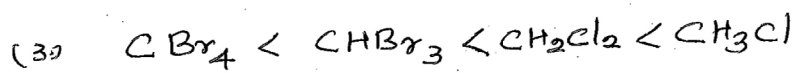
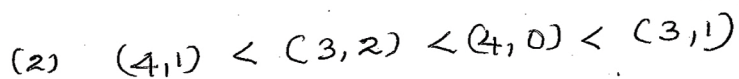
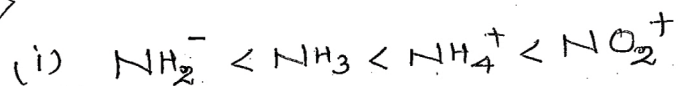
$$\text{H}-\ddot{\text{O}}-\text{C}=\ddot{\text{O}}-\text{H}$$

(15 marks)

← (8 × 0.1 = 08 marks)

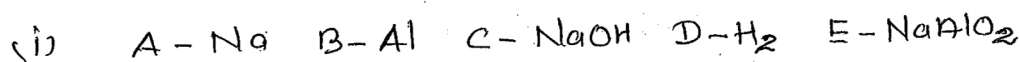
(vii) C₃O₂ ← (02 marks) (vi)

c)

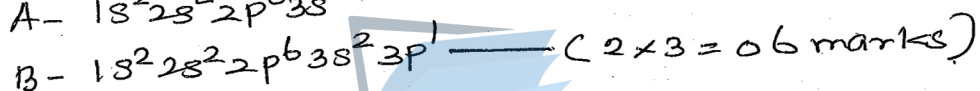
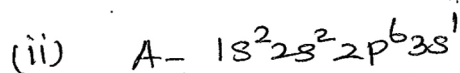


(5 × 5 = 25 marks)

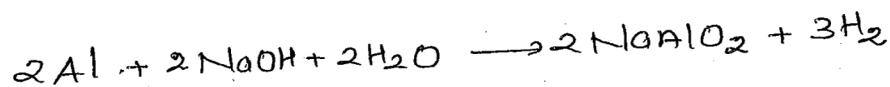
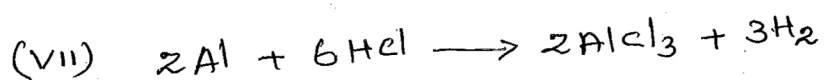
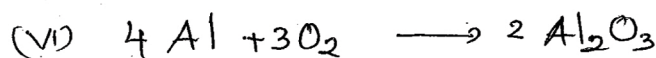
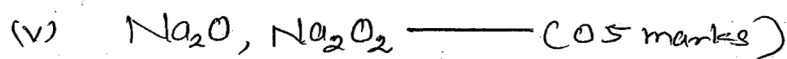
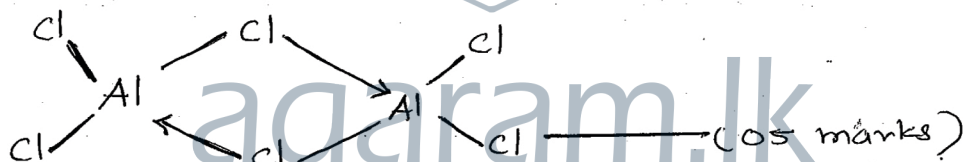
Q2.



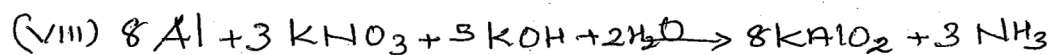
(5 × 2 = 10 marks)



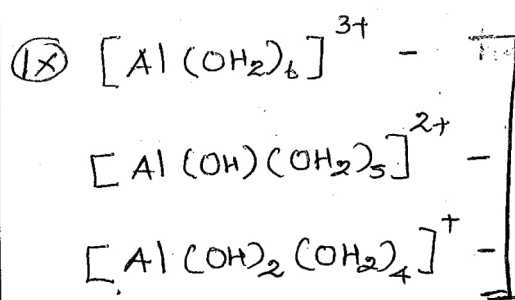
(iv)



(2 × 04 = 08 marks)



(06 marks)



(3x02 = 06 marks)

(x) A - Na $\Rightarrow$ Sodium lamp

B - Al $\Rightarrow$ electrical wire (2x02 = 04 marks)

b)

(1)

A - $LiNO_3$

D - NH_4NO_3

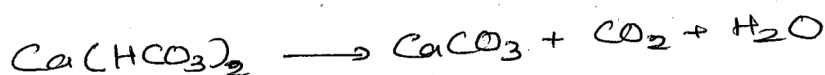
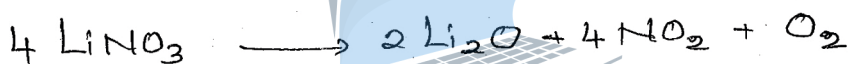
B - $(NH_4)_2Cr_2O_7$

E - $Ca(HCO_3)_2$

C - KNO_3

(5x3 = 15 marks)

(2)



(5x5 = 25 marks)

Q

3.

a)

(1)

A - Banson banner

D - Cotton wool

B - Delivery tube

E - Water

C - $KMnO_4$ (s)

(5)

(ii) $P_{O_2} = 745 \text{ mmHg} - 5 \text{ mmHg} = 740 \text{ mmHg}$ (5)

(iii) $P = \frac{1.01 \times 10^5 \text{ Nm}^{-2}}{760 \text{ mmHg}} \times 740 \text{ mmHg} = 0.98 \times 10^5 \text{ Nm}^{-2}$ (5)

$$(iv) \quad \frac{PV}{T} = k \quad \text{or} \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad \text{--- (5)}$$

$$(v) \quad V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$$

$$= \frac{0.98 \times 10^5 \text{ Nm}^{-2} \times 38 \times 10^{-6} \text{ m}^3 \times 273 \text{ K}}{1.01 \times 10^5 \text{ Nm}^{-2} \times 300 \text{ K}} \quad \text{--- (3)}$$

$$= 33.55 \times 10^{-3} \text{ dm}^3 \quad \text{--- (2)}$$

$$(vi) \quad m_{O_2} = 10.1481 \text{ g} - 10.1000 \text{ g} \quad \text{--- (3)}$$

$$= 0.0481 \text{ g} \quad \text{--- (2)}$$

$$(vii) \quad n_{O_2} = \frac{0.0481 \text{ g}}{32 \text{ g mol}^{-1}} \quad \text{--- (3)}$$

$$= 1.5 \times 10^{-3} \text{ mol} \quad \text{--- (2)}$$

$$(viii) \quad \text{molar Volume of } O_2 \text{ gas} = \frac{33.55 \times 10^{-3} \text{ dm}^3}{1.5 \times 10^{-3} \text{ mol}} \quad \text{--- (3)}$$

$$= 22.37 \text{ dm}^3 \text{ mol}^{-1} \quad \text{--- (2)}$$

(ix) I. Prevent of Sublimation of $KMnO_4$ } (5)

II. possible answer

- reactions does not finished (10 × 5 = 50 marks)
- temperature affect weight mass

(b)

I (i) Entropy is a measure of the disorder or randomness of a system.

(ii) The properties that depend on the amount or size of a system are called extensive properties

(iii) The variable like P, V, T and composition that are used to describe the state of a system are called state functions.

[5×3=15 marks]

b. II.

$$(i) \Delta H_R^\ominus = (4 \times -46 \text{ kJ mol}^{-1}) - (6 \times -242 \text{ kJ mol}^{-1})$$

$$= 1268 \text{ kJ mol}^{-1}$$

$$(ii) \Delta S^\ominus = (4 \times 193 \text{ J mol}^{-1} \text{ K}^{-1} + 3 \times 205 \text{ J mol}^{-1} \text{ K}^{-1})$$

$$- (2 \times 192 \text{ J mol}^{-1} \text{ K}^{-1}) + 6 \times 189 \text{ J mol}^{-1} \text{ K}^{-1})$$

$$= -131 \text{ J mol}^{-1} \text{ K}^{-1}$$

$$(iii) \Delta G^\ominus = \Delta H^\ominus - T \Delta S^\ominus$$

$$= 1268 \text{ kJ mol}^{-1} - 298 \text{ K} \times (-131 \times 10^{-3}) \text{ kJ mol}^{-1} \text{ K}^{-1}$$

$$= 1307.038 \text{ kJ mol}^{-1}$$

[3×10=30 marks]

$$(iv) T = \frac{\Delta H^\ominus}{\Delta S^\ominus}$$

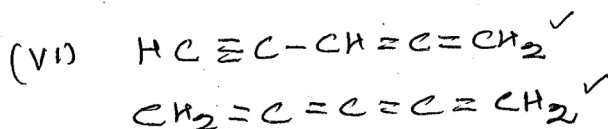
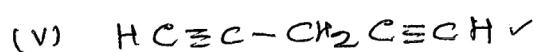
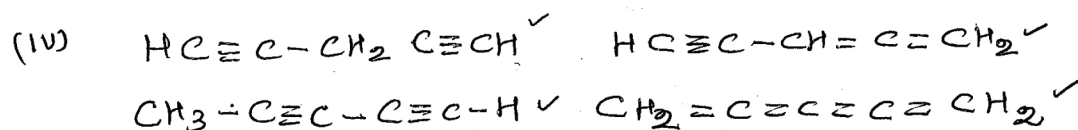
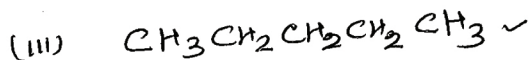
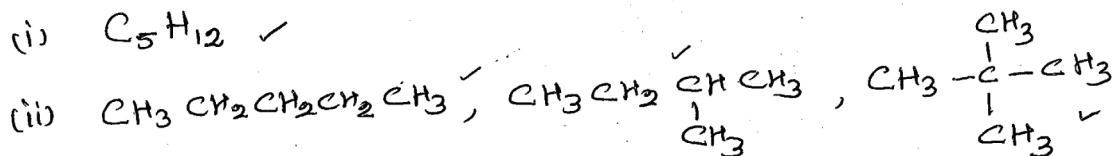
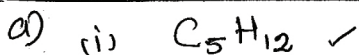
$$= \frac{1268 \text{ kJ mol}^{-1}}{131 \times 10^{-3} \text{ kJ mol}^{-1} \text{ K}^{-1}}$$

$$= 9679.3 \text{ K}$$

[05 marks]

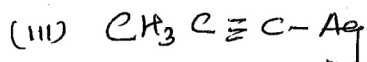
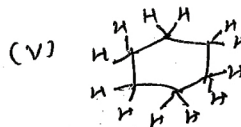
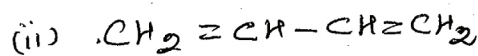
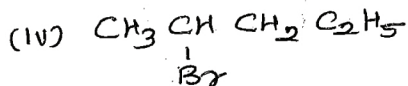
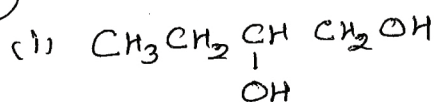
50+50

Q 4.

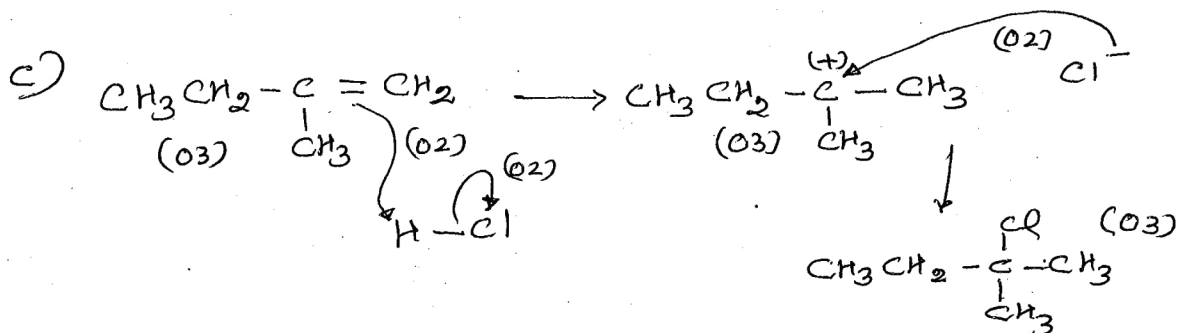


[12×05=60 marks]

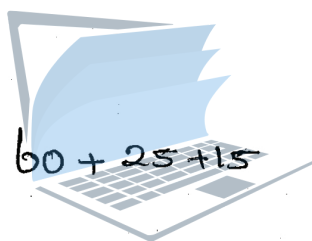
b)



(25 marks)



(15 marks)



100

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PART-B

Q5.

$$(1) n_{C_3H_8} : n_{SiH_4} : n_{CO_2} = \frac{2V \times 3P}{RT} : \frac{3V \times 2P}{RT} : \frac{8V \times P}{RT}$$
$$= 3 : 3 : 4 \quad \text{————— (5)}$$

$$\text{let } n_{C_3H_8} = 3n$$

$$\text{So, } n_{SiH_4} = 3n$$

$$n_{CO_2} = 4n$$

$$\text{Total mass} = 4.07 \text{ g}$$

$$3n \times 44 \text{ g mol}^{-1} + 3n \times 32 \text{ g mol}^{-1} + 4n \times 44 \text{ g mol}^{-1} = 4.07 \text{ g}$$

$$n = 1 \times 10^{-2} \text{ mol} \quad \text{————— (5)}$$

$$\text{Total mole of gases} = 10n$$
$$= 0.1 \text{ mol} \quad \text{————— (3)}$$

Final system

$$PV = nRT \quad \text{————— (2)}$$

$$V = \frac{0.1 \text{ mol} \times 8.314 \text{ J mol}^{-1} \text{ K}^{-1} \times 400 \text{ K}}{16.628 \times 10^4 \text{ Pa}} \quad \text{————— (5)}$$

$$= 2 \times 10^{-3} \text{ m}^3 \quad \text{————— (3)}$$

$$= 2 \text{ dm}^3$$

5_q, (23)

$$(ii) P_{CO_2} = X_{CO_2} \times P_T \quad \text{————— (3)}$$

$$= \frac{4}{10} \times 16.628 \times 10^4 \text{ Pa} \quad \text{————— (2)}$$

$$= 6.651 \times 10^4 \text{ Pa} \quad \text{————— (2)}$$

(iii) density $d = m/v$

$$= \frac{4.07g}{2dm^3} = 2.035 gdm^{-3} \text{ ————— (5)}$$

(iv) Pressure $p = P_T - P_{CO_2}$

$$= 16.628 \times 10^4 Pa - 6.651 \times 10^4 Pa \text{ ————— (3)}$$

$$= 9.977 \times 10^4 Pa \text{ ————— (2)}$$

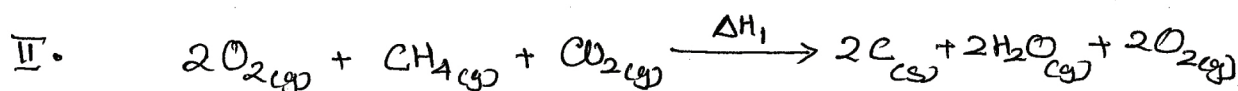
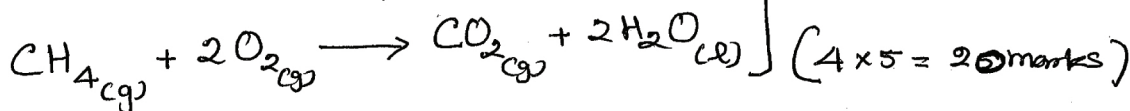
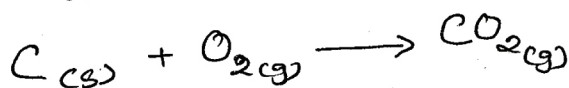
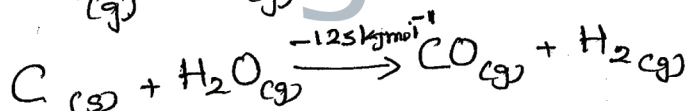
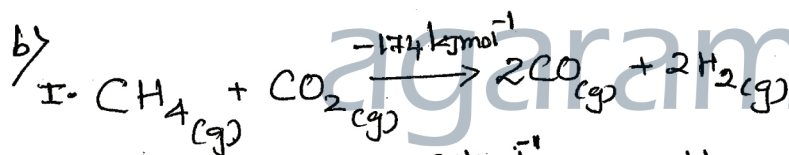
(v) Mass of the system = $4.07g - m_{CO_2}$

$$= 4.07g - 0.04mol \times 44g mol^{-1} \text{ ————— (3)}$$

$$= 2.31g \text{ ————— (2)}$$

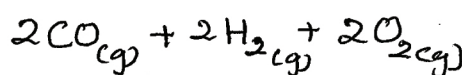
Density $d' = m'/v$

$$= \frac{2.31g}{2dm^3} = 1.16 gdm^{-3} \text{ ————— (5)}$$



$$\swarrow -174 kJmol^{-1}$$

$$\swarrow 2 \times -125 kJmol^{-1}$$

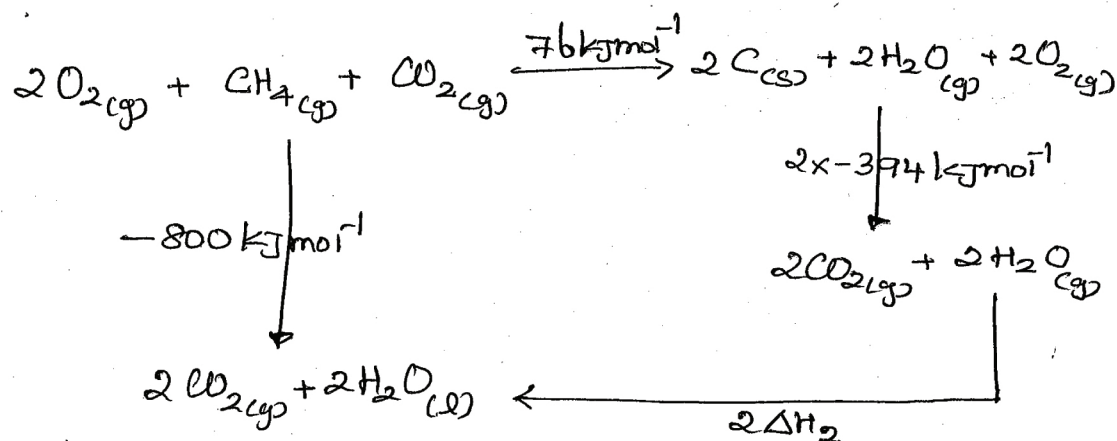


(15 marks)

Hess law

$$\Delta H_1 + 2 \times -125 \text{ kJ mol}^{-1} = -174 \text{ kJ mol}^{-1} \quad \text{--- (5)}$$

$$\Delta H_1 = 76 \text{ kJ mol}^{-1} \quad \text{--- (5)}$$



(4 × 5 = 20 marks)

Hess law

$$76 \text{ kJ mol}^{-1} + 2 \times -394 \text{ kJ mol}^{-1} + 2\Delta H_2 = -800 \text{ kJ mol}^{-1}$$

$$\Delta H_2 = -44 \text{ kJ mol}^{-1} \quad (2 \times 5 = 10 \text{ marks})$$

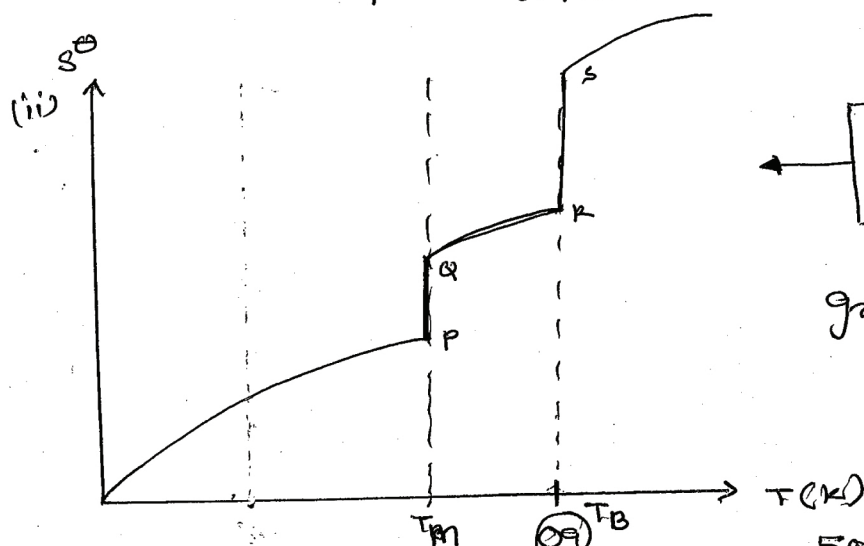
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5b. 75

(i) $\Delta G = \Delta H - T\Delta S \quad \text{--- (3)}$

$$\Delta G = 0 \quad \text{--- (2)}$$

$$\Delta S = \frac{\Delta H}{T} = \frac{6 \text{ kJ mol}^{-1}}{273 \text{ K}} = 21.9 \approx 22 \text{ J mol}^{-1} \text{ K}^{-1} \quad \text{--- (5)}$$



Consider $p_Q < p_S$

graph --- (10)

5c. 25

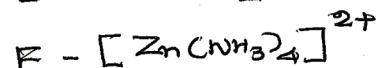
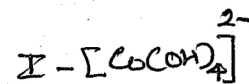
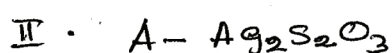
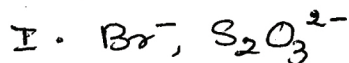
$$50 + 75 + 25 = 150$$

6

- a) A - NH_4NO_2 B - N_2 C - H_2O D - Mg_3N_2 E - $\text{Mg}(\text{OH})_2$
 F - NH_3 G - NiCl_3 H - HCl I - HOCl

(9 × 5 = 45 marks)

c)



(12 × 3 = 36 marks)

III.

J - tetrachloridocobaltate (II) ion

F - tetraamminezinc (II) ion

(2 × 4 = 8 marks)

IV.

The charge of the complex = Oxidation number of the central metal atom on the ion

Total charge of all ligands
 — (01)

-2

=

X

+ (-4)

— (2)

X

=

+2

— (2)

V.

1. Central metal ion

2. The oxidation state of the central metal ion.

3. Nature of the ligands

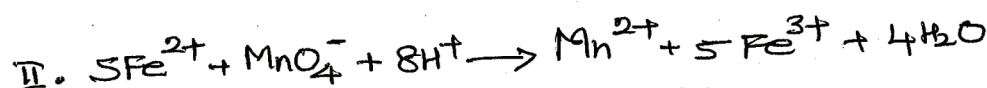
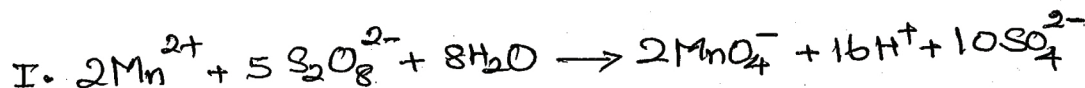
— (06)

b_c

55

b)

(1)



[2 × 5 = 10 marks]

(20) Let the thickness of the Mn layer be y cm ✓

$$\begin{aligned}\text{Area of the rectangular sample} &= 10\text{cm} \times 4\text{cm} \checkmark \\ &= 40\text{cm}^2 \checkmark\end{aligned}$$

$$\text{Volume of Mn layer} = 40y \text{ cm}^3 \checkmark$$

$$\text{Mass of Mn layer} = 40y \times 13.75 \text{ g} \checkmark$$

$$\text{Moles of Mn in the layer} = \frac{40y \times 13.75}{55} \text{ mol} \checkmark$$

$$\text{Molar mass of } \text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} = 392 \text{ g mol}^{-1} \checkmark$$

$$\begin{aligned}\text{Therefore, moles of Ferrous (Fe}^{2+}\text{)} &= \frac{2.94\text{g}}{392\text{g mol}^{-1}} \checkmark \\ &= 7.5 \times 10^{-3} \text{ mol} \checkmark\end{aligned}$$

$$\begin{aligned}\text{Moles of KMnO}_4 \text{ used to titrate} \\ \text{excess Fe}^{2+} &= 0.025 \text{ mol dm}^{-3} \checkmark \\ &\quad \times 20 \times 10^{-3} \text{ dm}^3 \\ &= 5 \times 10^{-4} \text{ mol} \checkmark\end{aligned}$$

$$n_{\text{Fe}^{2+}} : n_{\text{MnO}_4^-} = 5 : 1 \checkmark$$

$$\begin{aligned}\text{Moles of excess Fe}^{2+} &= 5 \times 5 \times 10^{-4} \text{ mol} \checkmark \\ &= 2.5 \times 10^{-3} \text{ mol} \checkmark\end{aligned}$$

Therefore, moles of Fe^{2+} reacted with MnO_4^- formed
as a result of dissolution of Mn layer in the
Sample = $7.5 \times 10^{-3} - 2.5 \times 10^{-3}$ ✓

$$= 5 \times 10^{-3} \text{ mol} \checkmark$$

Therefore, moles of MnO_4^- due to dissolution
of Mn layer = $\frac{1}{5} \times 5 \times 10^{-3} \text{ mol} = 1 \times 10^{-3} \text{ mol} \checkmark$

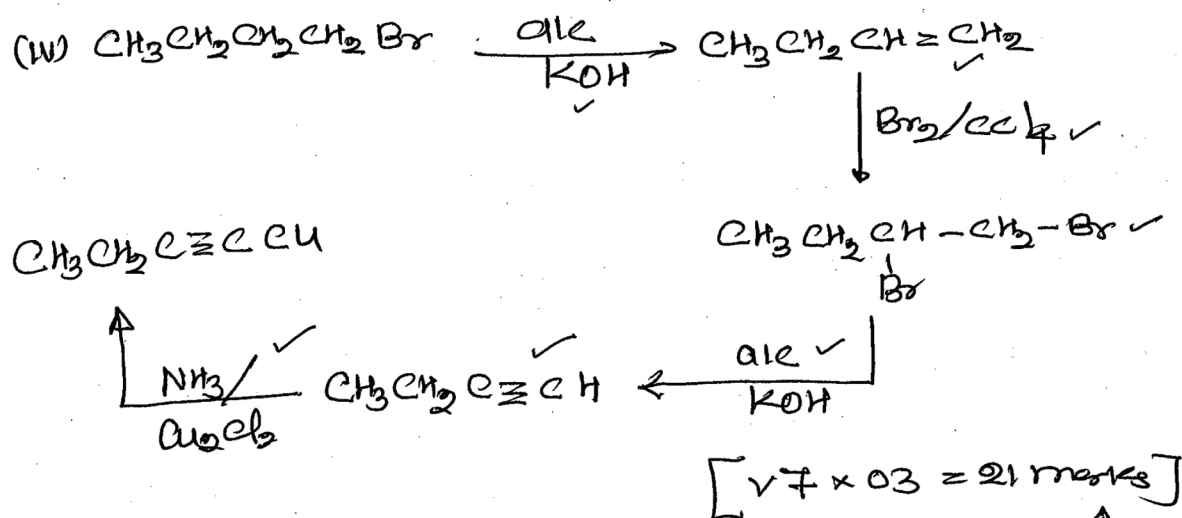
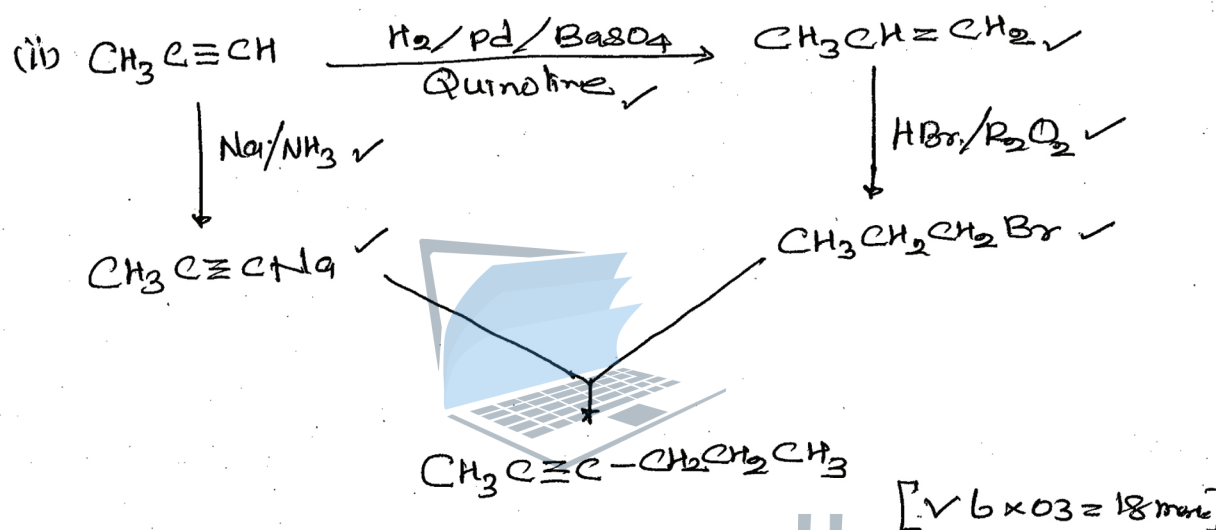
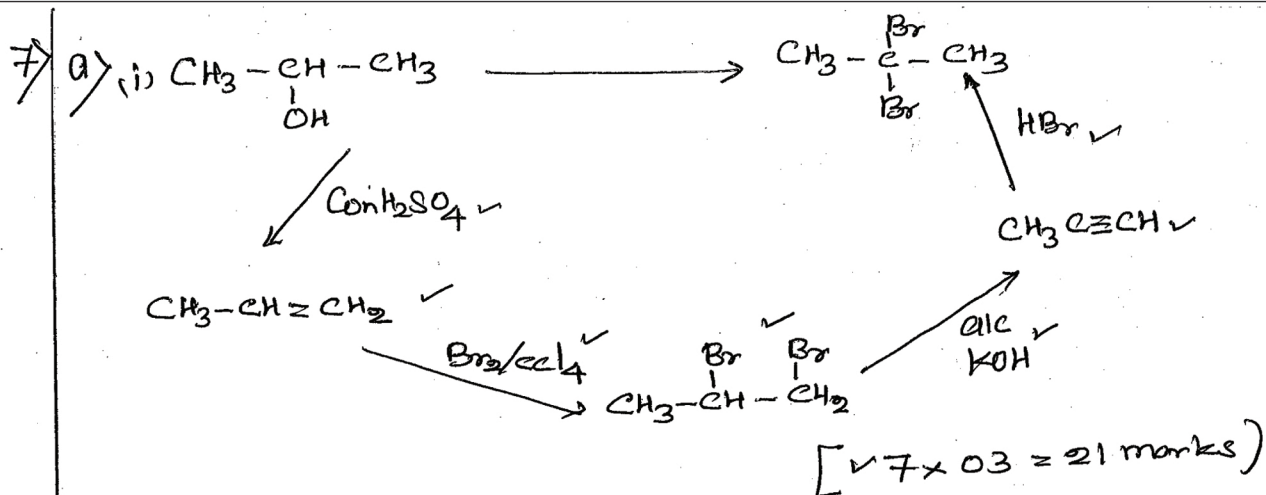
$$\text{Therefore moles of Mn}^{2+} = 1 \times 10^{-3} \text{ mol} \checkmark$$

$$\frac{40y \times 13.75}{55} = 1 \times 10^{-3} \checkmark$$

$$y = 1 \times 10^{-4} \checkmark$$

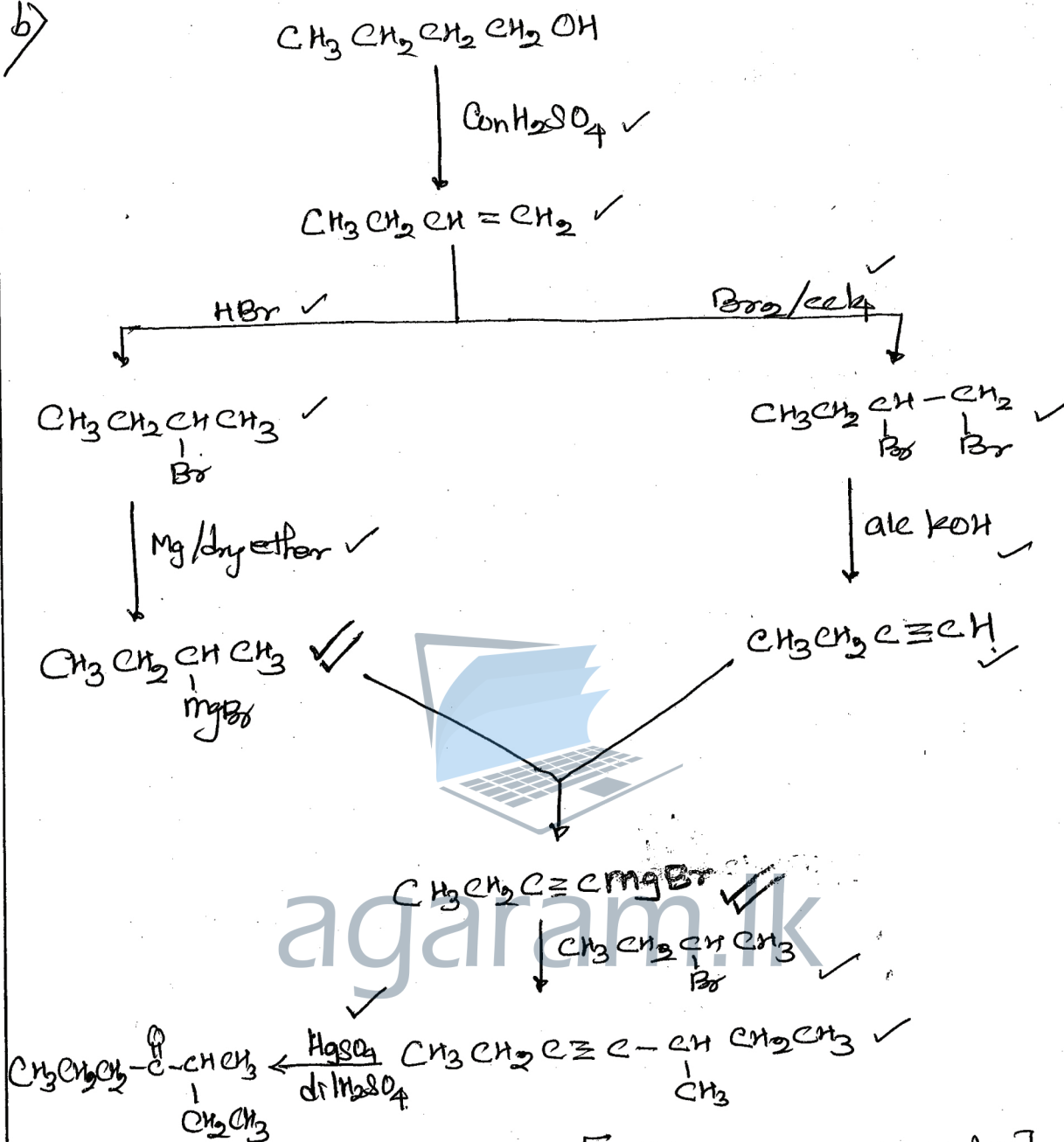
[20 ✓ × 2 = 40 marks]

$$45 + 40 + 55 = 150$$



69

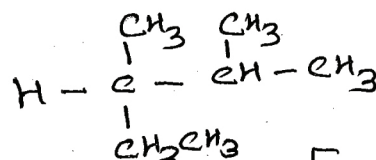
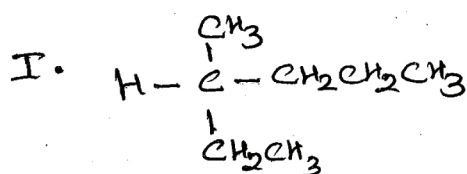
b)



[✓ 12 × 2.5 = 30 marks]
 [✓ 2 × 0.6 = 12 marks]

42

c)

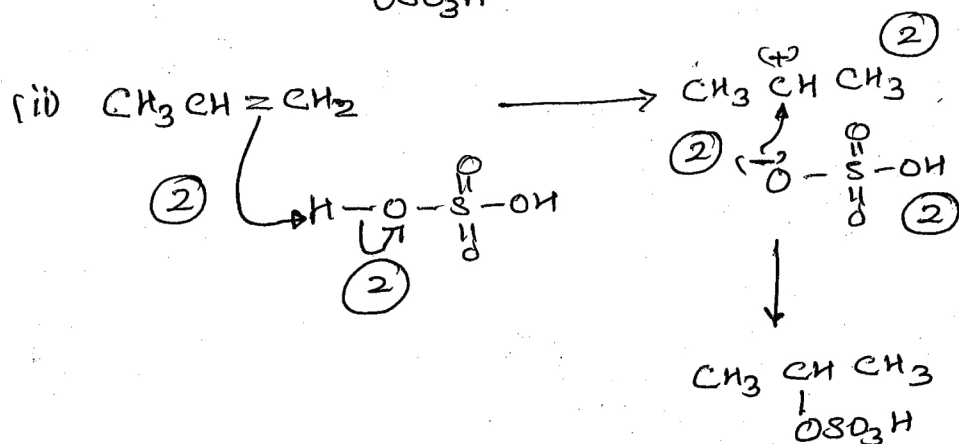
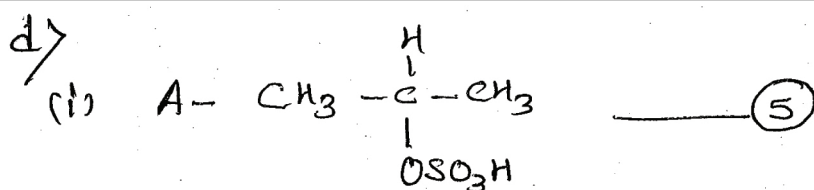


[10 marks]

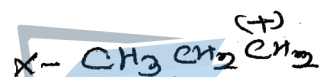
II. Chain isomers

[05 marks]

15



(iii) Intermediate carbocation for B



Intermediate carbocation of A



X- Primary carbocation, less stable — (3)

Y- Secondary carbocation, more stable — (3)

So, major product is A

24

150

MCQ Part I - $2 \times 25 = 50$

Part II A - $4 \times 100 = 400$

II B - $2 \times 150 = 300$

14 $\overline{700}$

Part II $\rightarrow 50$

Part I + Part II = 100