G.C.E. A/L Examination July - 2016

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In Collaboration with
Zonal Department of Education Jaffna.

FWC

Grade :- 12 (2017	Marking Scheme	Chemistry

Part II

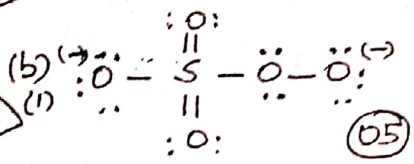
A – Structured Essay

Q1 (30)

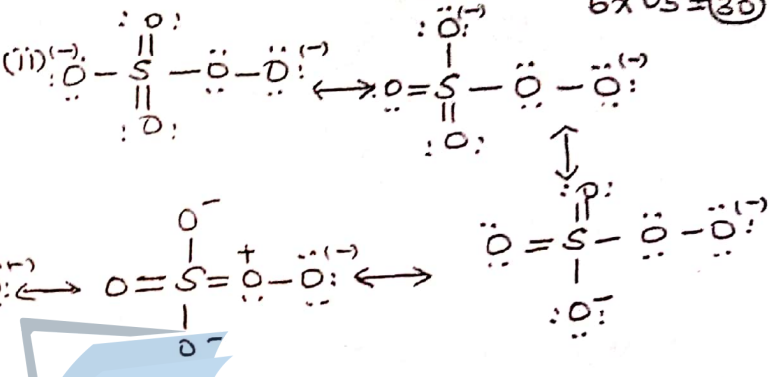
(a) (i) NCl_3 (ii) $Na_2S_2O_3$ (iii) XeF_4 (iv) $Cd(NO_3)_2$ (v) BF_3 (vi) CO_2

6 × 05 = (30)

(b) (i) A3 (05)



(ii)



any six resonance structures 6 × 03 = (18)

(iii) (a) SP^3, SP^3 (b) SP^3, $2P/SP^3$ ---- 4 × 02 = (08)

(iv)

	S	O_b
Electron pair geometry	Tetrahedral	Tetrahedral
shape	Tetrahedral	Angular
Bond angle	~109°	~104°

6 × 02 = (12)

(c) (i) $HCHO < HCOOH < HCN < CO_2$ ---- (03)

Q7 (06)

	Hybridization	Oxidation state
HCHO :	SP^2	0
HCOOH :	SP^2	+2
HCN :	SP	+2
CO_2 :	SP	+4

When the s character in the hybridization increases electronegativity will increase. Higher the +charge/oxidation state, greater the electronegativity

(ii) $Na < Zn < V$ ---- (03)

(06)

Na – s block elt. Only one valence e⁻ participating in metallic bond. Metallic bond is not so strong.

Zn, V – d block elts. No of valence e⁻s. in metallic bond high.

Zn – $4s^2d^{10}$ str. Less contribution to metallic bond.

V has more free e⁻s participating in metallic bond.

(iii) $Be(NO_3)_2 < Mg(NO_3)_2 < Ba(NO_3)_2$ ----- (03)

(06) Anion is the same. Cationic charge same.
Size $Be^{2+} < Mg^{2+} < Ba^{2+}$
With the increase in size, polarizing ability decreases
∴ Ionic character increases.

3 x 09 = (27)

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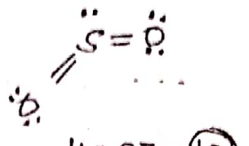
2. (a) (i) X = O , Y = S 2 x 05 = (10)

(35) (ii) $Y_1 \Rightarrow SO_2$ ... , $Y_2 \Rightarrow SO_3$ -- (iii) H_2S ... (03)



4 x 03 = (12)

(iv) $2H_2S + SO_2 \longrightarrow 3S + 2H_2O$ (03)

(v) Structures of Rhombic and monoclinic sulphur 2 x 02 = (04)

(vi) $2Mg + SO_2 \longrightarrow 2MgO + S$ (02) or $3Mg + SO_2 \longrightarrow 2MgO + Mg_2S$

as an oxidizing agent (01)

(b) (i) M = Cu (05) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$ (05)

(35) (ii) $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + 2SO_2 + 2H_2O$ (05)

(iii) CuO - black
Cu_2O - red
} 2 x 03 = (06)

(iv) $[Cu(NH_3)_4]^{2+}$ deep blue. (04)

(v) $[CuCl_4]^{2-}$ - tetrachloridocuprate (II) (04)

(vi) (I) Blue sol^n - turns colourless
(II) Formation of black precipitate
} 2 x 03 = (06)

(30) (c) (i) A = $AgNO_3$ B = $(NH_4)_2SO_4$, C = $Pb(NO_3)_2$, D = $(NH_4)_2Cr_2O_7$
E = NH_4NO_3
5 x 03 = (15)

(ii) $2AgNO_3 \xrightarrow{\Delta} 2Ag + NO_2 + O_2$

$(NH_4)_2SO_4 \xrightarrow{\Delta} 2NH_3 + H_2SO_4$

$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

$NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

5 eqns → 5 x 03 = (15)

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3 (a) (I) Definitions. 3 x 05 = (15)

(50) (II) (i) $C_2H_5OH_{(l)} + 3O_{2(g)} \xrightarrow{-1368\ kJmol^{-1}} 2CO_{2(g)} + 3H_2O_{(l)}$

ΔH_f°

$2C_{(s/Gra.)} + 3H_{2(g)} + \frac{7}{2}O_{2(g)}$

$2 \times -394\ kJmol^{-1}$

$3 \times -286\ kJmol^{-1}$

cycle → (10)

∴ Using Hess's law, (05)

$\Delta H_f^\theta - 1368\ kJ\ mol^{-1} = 2\times -394\ kJ\ mol^{-1} + 3\times -286\ kJ\ mol^{-1}$

$\Delta H_f^\theta = -278\ kJ\ mol^{-1}$ (05)

(ii) Heat liberated by 46 g of C_2H_5OH = 1368 kJ

∴ 0.023 kg of $C_2H_5OH \longrightarrow \frac{1368\times 0.023\times 1000}{46}$ kJ

= 684 kJ (05)

(iii) $684\times10^3\ J = 12\times10^{-3}\ m^3 \times 1000\ kg\ m^{-3} \times (4200\ J\ kg^{-1}\ K^{-1})\ \theta$ (05)

$\Rightarrow \theta = \frac{684\times10^3}{12\times4200} = 13.5\ K$. (05)

(b) (i) $\Delta G = \Delta H - T\Delta S$ ..... (05)

30 For spontaneity $\Delta G < 0$ ∴ $\Delta H - T\Delta S < 0$ ---- (05)

(ii) (a) $\Delta S^\theta = (40 + 214 - 92.8)\ J\ mol^{-1}K^{-1} = 161.2\ J\ mol^{-1}K^{-1}$ (05)

(b) $\Delta H^\theta = [(635 - 394) - (-1206)]\ kJ\ mol^{-1} = 1777\ kJ\ mol^{-1}$ (05)

(c) $\Delta G^\theta = 1777\ kJ\ mol^{-1} - 298\ K \times 0.1612\ kJ\ mol^{-1}K^{-1} = 1728.70\ kJ\ mol^{-1}$ (05)

Since $\Delta G^\theta > 0$, the reaction is non spontaneous.

For spontaneity, $T_{min} = \frac{\Delta H}{\Delta S} = 1092.94\ K$ (03)

(d) Temperature dependance of ΔH and ΔS neglected. (02)

(c) (i) The maximum temperature at which a gas can be converted to a liquid by compression ---- (03)

30 (ii) $He < CO_2 < NH_3$ ------ (03)

(iii) Z

1.0

He

Ideal gas

NH_3

P

Sketch → (05)

Labelling → (05)

(iv) When the intermolecular attractive forces of a real gas are strong, Z value decreases so the critical temp: increases. (04)

4 (a) (i) 40

A: $CH_3-CH(CH_2CH_3)-CH=CH-CH_3$

B: $CH_3-CH(CH_2CH_3)-CH_2CH=CH_2$

C: $CH_3-CH(CH=CH_2)-CH_2CH_3$

D: $CH_3-CH(CH_2CH_3)-CH_2CH_2CH_3$

$4\times04 = 16$

(ii)

E: $CH_3-C(CH_2CH_3)=CH-CH=CH_2$

F: $CH_3-CH(CH_2CH_3)-C\equiv C-CH_3$

$CH_3-CH(CH_2CH_3)-CH_2-C\equiv CH$ — G

$CH_3-CH(CH_2CH_3)-CH_2CH_2CH_3$ — H. 4 × 04 = 16

(B and C can be interchanged and accordingly G and

(iii) Adding $NH_3/AgNO_3$
G gives white ppt. F does not .. 04

(iv) I ⇒ $CH_3-CH(CH_2CH_3)-CH(CH_3)-CH_3$ 04

(b) (i) 30

1% (cold) alkaline $KMnO_4$ — J

dil. H_2SO_4, $HgSO_4$ Δ — K

alcohol/KOH — L

H_2/Lindlar catalyst — M

Con. H_2SO_4, Δ — N

$NH_3/AgNO_3$

6 × 05 = 30

(c) (i) 30

$CH_3-CH=CH_2$ — P

$CH_3-CH(Br)-CH_2(Br)$ — Q

$CH_3-C\equiv CH$ — R

(ii)

Br_2/CCl_4 — X

ethanol/KOH — Y

dil. H_2SO_4, $HgSO_4$, Δ — Z

6 × 05 = 30

Essay 5 × 05 = 25

(5) (a) (i) A = Ba, B = H_2, C = $Ba(OH)_2$, D = Ba_3N_2, E = $BaCO_3$ 50

(ii) $Ba_3N_2 + 6H_2O \longrightarrow 3Ba(OH)_2 + 2NH_3$ 05

(iii) Turns Nessler's reagent brown / Gives dense white fumes with HCl 05

(iv) $NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$ 05

(v) Evolution of gas
Dissolution of solid
} 2 × 05 = 10

(b)(I)(i) Presence of transition elt cation 60
(ii) Absence of Ag^+, Pb^{2+} and Hg_2^{2+}
(iii) Sb^{3+} (iv) Cr^{3+} / $Cr(OH)_3$ obtained
(v) Zn^{2+} (vi) CrO_4^{2-}
} 6 × 04 = 24

(II) The three cations are Sb^{3+}, Cr^{3+}, Zn^{2+} 3 × 04 = 12

(III) $2Cr(OH)_3 + 4NaOH + 3H_2O_2 \longrightarrow 2Na_2CrO_4 + 8H_2O$ 10

CrO_4^{2-} 05

(IV) yellow ⟶ orange 04

$2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$ 05

(5) (i) $2KCl + MnO_2 + 2H_2SO_4 \longrightarrow K_2SO_4 + MnSO_4 + Cl_2 + 2H_2O$

(ii) $Ag_2O + H_2O_2 \longrightarrow 2Ag + H_2O + O_2$

(iii) $H_2S + 2HNO_3 \longrightarrow S + 2NO_2 + 2H_2O$

(iv) $KIO_3 + 6HCl + 5KI \longrightarrow 6KCl + 3I_2 + 3H_2O$

(v) $4LiNO_3 \longrightarrow 2Li_2O + 4NO_2 + O_2$

$5 \times 07 = 35$

(vi) $Mg + 2NH_4Cl \longrightarrow MgCl_2 + 2NH_3 + H_2$ --- 05

(6) (a) Let n_1 and n_2 be the respective amts of $KClO_3$ and KCl present in 25 cm^3 of the initial sol^n.

$$n_1 + n_2 = \frac{0.1435\ g}{143.5\ g\,mol^{-1}} = 1 \times 10^{-3}\ mol \quad \text{---} (1)$$ 05

In expt. II : $ClO_3^- + 6Fe^{2+} + 6H^+ \longrightarrow Cl^- + 6Fe^{3+} + 3H_2O$

$5Fe^{2+}_{(remaining)} + MnO_4^- + 8H^+ \longrightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$ 05

Initial $n_{FeSO_4} = 0.2\ mol\,dm^{-3} \times 30 \times 10^{-3}\ dm^3$

$= 6 \times 10^{-3}$ mol 05

Amt. of $KMnO_4$ required for the oxidation of remaining $Fe^{2+} = 5 \times 0.08 \times 10^{-3} \times 7.5$ mol 05

$\therefore$ Amt. of remaining $n_{Fe^{2+}} = 5 \times (0.08 \times 10^{-3} \times 7.5)$ mol

$= 3 \times 10^{-3}$ mol 05

Amt. of Fe^{2+} reacted with $ClO_3^- = (6 \times 10^{-3} - 3 \times 10^{-3})$ mol

$= 3 \times 10^{-3}$ mol 05

$\therefore$ Amt. of $ClO_3^- = \frac{1}{6} \times 3 \times 10^{-3}$ mol

$\Rightarrow n_1 = 5 \times 10^{-4}$ mol 05

From eqn. (1) $\Rightarrow n_2 = 5 \times 10^{-4}$ mol

In 250 cm^3 of the initial sol^n.

amt. of $KClO_3 = 5 \times 10^{-3}$ mol

amt. of $KCl = 5 \times 10^{-3}$ mol } $2 \times 05 = 10$

molar ratio $KClO_3 : KCl = 1 : 1$ 05

mass of $KClO_3 = 5 \times 10^{-3}\ mol \times 122\ g\,mol^{-1}$

$= 0.61$ g 08

mass of KCl $= 5 \times 10^{-3}\ mol \times 74.5\ g\,mol^{-1}$

$= 0.3725$ g 03

mass of moisture in 1g sample = 1g − (0.61 + 0.3725)g

= 0.0175 g (02)

mass % of moisture = $\frac{0.0175g}{1g} \times 100\%$ =

= 1.75% (02)

(b) Let the amts (in moles) of $CaCO_3$ and $MgCO_3$ in the mixture be x and y respectively.

45

$100x + 84y = 1.64$ g ——— ① (05)

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

$MgCO_3 + 2HCl \longrightarrow MgCl_2 + H_2O + CO_2$ } 2 × 05 = (10)

HCl (remaining) $+ NaOH \longrightarrow NaCl + H_2O$ (05)

$n_{HCl(remaining)} = 0.25\ mol\ dm^{-3} \times 16 \times 10^{-3}\ dm^3 = 4 \times 10^{-3}$ mol

Initial amt in moles of HCl = $0.8\ mol\ dm^{-3} \times 50 \times 10^{-3}\ dm^3$

= 40×10^{-3} mol (05)

∴ Reacted amt of HCl = $(40 - 4) \times 10^{-3}$ mol

= 36×10^{-3} mol (05)

$2x + 2y = 36 \times 10^{-3}$

$x + y = 18 \times 10^{-3}$ (05) ——— ②

①, ② ⇒ $x = 0.008$ mol, $y = 0.01$ mol ---- (04)

Mass of $CaCO_3$ = 0.8 g

Mass of $MgCO_3$ = 0.84 g } 2 × 02 = (04)

∴ Mass % of $CaCO_3$ = $\frac{0.8}{1.64} \times 100\%$ = 47.98%

Mass % of $MgCO_3$ = 52.02% (02)

(c) (i) Br_2 non-polar molecule.

45

Intermolecular forces are weak (London forces)

ICl polar molecule.

Dipole – dipole interaction exists which is stronger than London forces

(ii) Mg has stable electron configuration of $3s^2$.

Addition of an e^n disturbs the stability

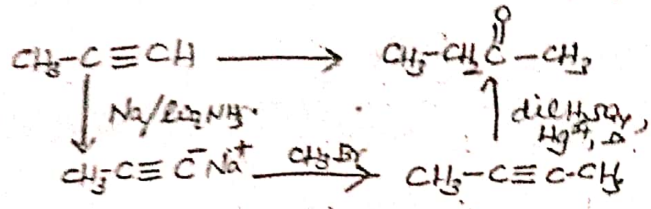
∴ Energy is required to add the e^n.

(iii) $I_2 - H_2O$ Induced dipole – dipole interaction

$KI - I_2$ ion – induced dipole and also due to the formation of I_3^- ($I_2 + I^- \rightleftharpoons I_3^-$)

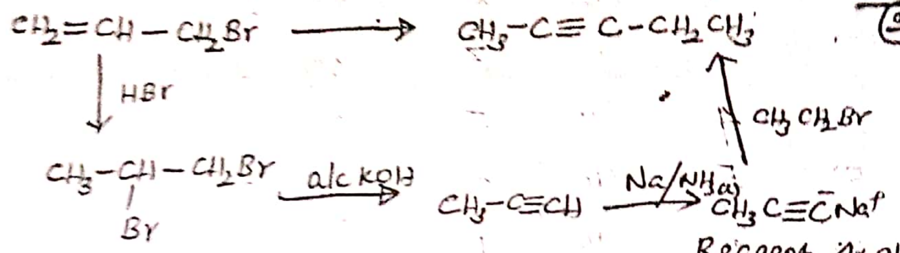
3 explanations → 3 × 15 = (45)

(7) (a) (i) [54]



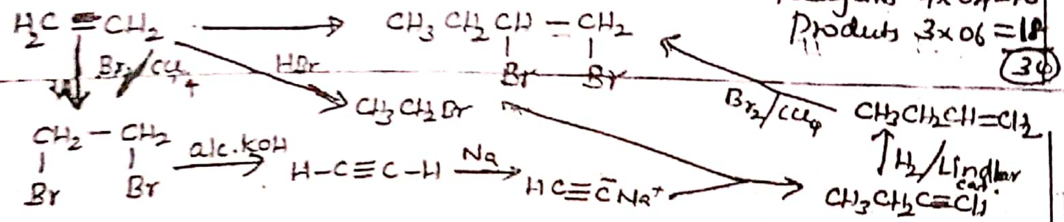
Reagents 3×04 = 12
Products 2×06 = 08
(20)

(ii)



Reagents 4×04 = 16
Products 3×06 = 18
(34)

(b) [34]



Reagents 6×02 = 12
Products 7×03 = 21
33 + 01 (Bonus)
34

(c) [42] (I) $C_5H_y + (5+\frac{y}{4})\,O_2 \longrightarrow 5CO_2 + \frac{y}{2}H_2O$

$10\ cm^3 \qquad 65\ cm^3$

$$\frac{1}{5+y/4} = \frac{10}{65} \Rightarrow y = 6 \quad (10)$$

$Q \Rightarrow C_5H_6$

(II) $C_5H_6 + nH_2 \longrightarrow C_5H_{12}$ (saturated)

$\Rightarrow n = 3$ (10)

(III)

(11) (11)

(d) [20] (I) $CH_3CH_2C\equiv CH$ gives white precipitate with $NH_3/AgNO_3$ whereas $CH_3-C\equiv C-CH_3$ does not.

(II) Decolourizing $Br_{2(aq)}$ / $H^+, KMnO_4$ → $CH_3CH=CH_2$

2×10 = (20)

Q(7) ⇒ (a) 54 (b) 34 (c) 42 (d) 20 ⇒ [150]

Part I

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

Final marks

Part I – 25 × 02 = 50%.

Part II – Structure 4 × 100 = 400

Essay 2 × 150 = 300

700

14 | 700

50%.