இரசாயனவியல்
Chemistry

Gr -12 (2023)

marking scheme

பகுதி - I

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

$25 \times 02 = 50$

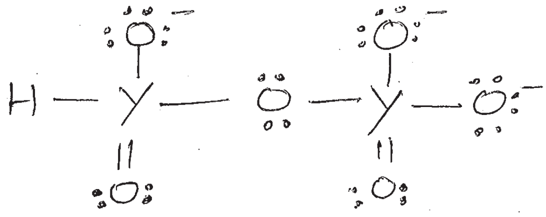
பகுதி II

அமைப்புக்கட்டமை (Structure)

(1) (a) (i) K (ii) S_8 (iii) F (iv) H_2O_2 (v) CH_3COOH
(vi) O

$6 \times 05 = 30$

(b) I



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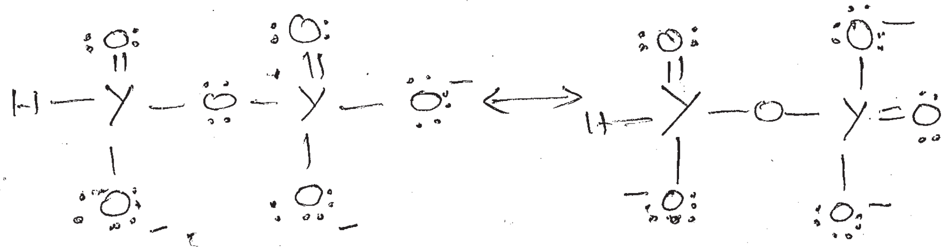
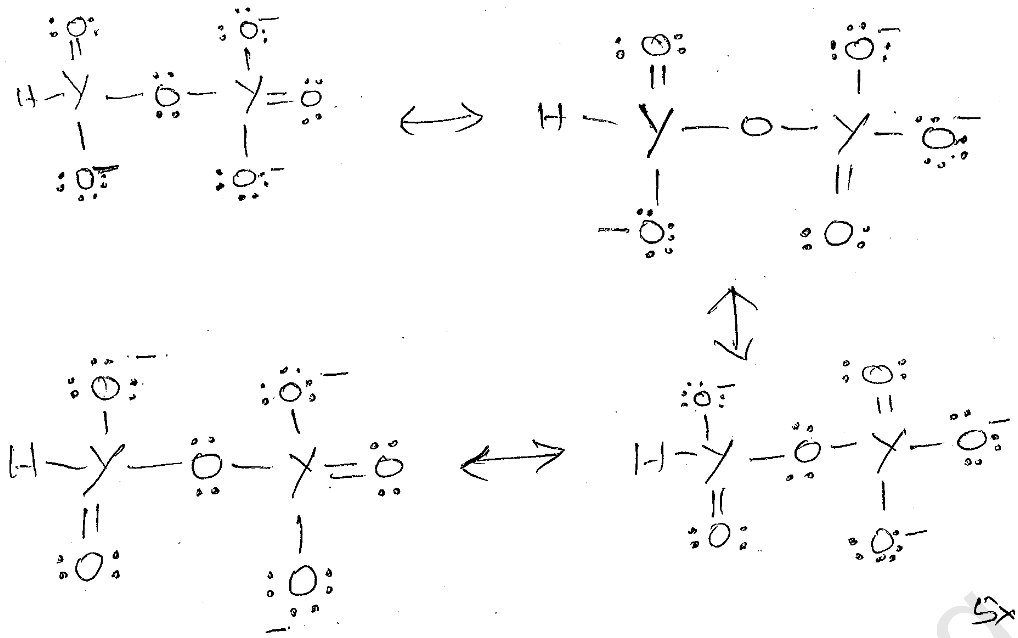
II $15^{ம்}$ கூட்டம் (GP 15) 5

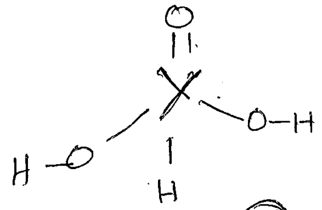
(III)



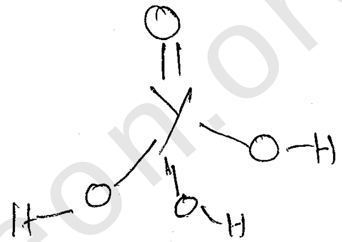


$5 \times 03 = 15$

(iv)



A 4



B 4

(v) VSEPR Pairs = 5

lone pair = 0

σ bond pair = 4

Shape = Tetrahedral. 5

(vi) A $\rightarrow sp^3$ B $\rightarrow sp^3$ 4

(vii) $1s^2 2s^2 2p^6 3s^2 3p^5$ 3

(viii) B 3

$\because$ No of H-bonds. A < B 5

(C)

	n	l	m_l	atomic Orbital
(i)	$\boxed{3}$	$\boxed{2}$	-2	3d
(ii)	2	$\boxed{1}$	$\boxed{0}$	2p
(iii)	$\boxed{3}$	$\boxed{0}$	$\boxed{0}$	3s
(iv)	3	$\boxed{2}$	-2	$\boxed{3d}$

$9 \times 01 = 9$

(1)

(d) (i) True (✓)
(ii) ~~Fa~~lse (X)
(iii) False (X)

$3 \times 01 = 03$

$Q_1 \rightarrow 100$

2) (i) A = $AgNO_{3(aq)}$ 10 B = $BaCl_{2(aq)}$ 10

(ii) Brown Ring Test 10

(a) First the ion solution is taken into the test tube Then newly made $FeSO_{4(aq)}$ is added into the Solution After that concentrated H_2SO_4 is added slowing and carefully along the wall of the tube. Then a brown ring occurs where the both solutions contanct

(b) $2AgNO_{3(s)} \xrightarrow{\Delta} 2Ag_{(s)} + O_{2(g)} + 2NO_2 \uparrow$ 5

(iii) diammine silver (I) chloride 5

or

diammine silver chloride. $[Ag(NH_3)_2]Cl$ 5

IV a) $2NO_2 + H_2O \longrightarrow HNO_3 + HNO_2$ 5

(b) Disproportionation Reaction 5

(c) $4HNO_{3(aq)} \longrightarrow 4NO_{2(g)} + O_{2(g)} + 2H_2O_{(l)}$

$3HNO_{2(aq)} \longrightarrow HNO_{3(aq)} + 2NO_{(g)} + H_2O_{(l)}$ 3

(V) $BaCl_{2(aq)} + H_2SO_{4(aq)} \longrightarrow BaSO_{4(s)} + 2HCl_{(aq)}$ 3

$2AgNO_{3(aq)} + 2NaOH_{(aq)} \longrightarrow 2AgOH_{(s)} + 2NaNO_{3(aq)}$

$\downarrow$

$Ag_2O_{(s)} + H_2O_{(l)}$ 4

(B)

(i)	$PCl_{3(g)}$	Polar covalent	Dipole - Dipole
(ii)	$CH_3-\overset{O}{\overset{\|}{C}}-Cl_{(g)}$	Polar covalent	Dipole - Dipole
(iii)	$NaCl_{(s)}$	Ionic	—
(iv)	$He_{(g)}$	Nonpolar covalent	London dispersion
(v)	$NH_{3(aq)}$	Polar covalent	Hydrogen bond

~~10 x~~ $10 \times 3.5 = 35$ $Q_2 \rightarrow 100$

3) (a) I. • Given molecules must be collided with each other
• Colliding molecules should have energy greater than activation energy
• Molecules should collide in proper orientation

$3 \times 04 = 12$

II $\text{Rate} = -\frac{1}{a}\frac{\Delta[A_{(g)}]}{\Delta t} = -\frac{1}{b}\frac{\Delta[B_{(g)}]}{\Delta t} = \frac{1}{c}\frac{\Delta[C_{(g)}]}{\Delta t} = \frac{1}{d}\frac{\Delta[D_{(g)}]}{\Delta t}$ (10)

III $\text{Rate} = k[O_{2(g)}][NO_{(g)}]^2$

$k = \frac{\text{Rate}}{[O_{2(g)}][NO_{(g)}]^2}$ (5)

$= \frac{3.2 \times 10^{-3}\ mol\,dm^{-3}\,s^{-1}}{(1 \times 10^{-2}\ mol\,dm^{-3})(2 \times 10^{-2}\ mol\,dm^{-3})^2}$ (5)

$= 8 \times 10^{2}\ mol^{-1}\,dm^{6}\,s^{-1}$ (5)

(b) (i) $\text{Rate} = k[A]^a[B]^b[C]^c$ (5)

(ii) $8 \times 10^{-4}\ mol\,dm^{-3}\,s^{-1} = k(0.1\ mol\,dm^{-3})^a(0.1\ mol\,dm^{-3})^b(0.1\ mol\,dm^{-3})^c$ — ①

$1.6 \times 10^{-3}\ mol\,dm^{-3}\,s^{-1} = k(0.2\ mol\,dm^{-3})^a(0.1\ mol\,dm^{-3})^b(0.1\ mol\,dm^{-3})^c$ — ②

$3.2 \times 10^{-3}\ mol\,dm^{-3}\,s^{-1} = k(0.2\ mol\,dm^{-3})^a(0.2\ mol\,dm^{-3})^b(0.1\ mol\,dm^{-3})^c$ — ③

$3.2 \times 10^{-3}\ mol\,dm^{-3}\,s^{-1} = k(0.1\ mol\,dm^{-3})^a(0.1\ mol\,dm^{-3})^b(0.2\ mol\,dm^{-3})^c$ — ④

②/① $2 = 2^a$, $a = 1$, $b = 1$ $c = 2$

40

3) (b) (III) Rate = k [A][B][C]^2 (6)

(IV) Rate of reaction increased by $3^2 = 9$ times of initial Rate. (10)

$Q_3 \rightarrow 100$

4) a(I)

A $CH_3-CH(CH_3)-C(=O)-CH_3$

B $CH_3CH_2CH_2-C(=O)-CH_3$

C $CH_3CH_2-C(=O)-CH_2CH_3$

D $CH_3CH_2-CH(CH_2OH)-CH_3$

E $CH_3-CH(CH_3)-CH(OH)-CH_3$

F $CH_3CH_2CH_2-CH(OH)-CH_3$

G $CH_3CH_2-CH(OH)-CH_2CH_3$

X $CH_3CH_2-C(CH_3)=CH_2$

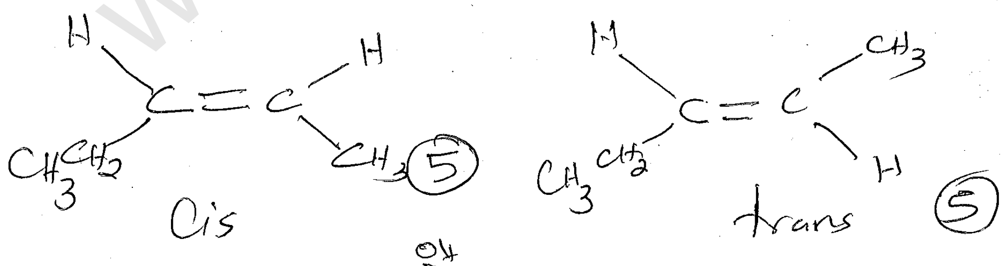
Z $CH_3CH_2\,CH=CH\,CH_3$

Y $CH_3-C(CH_3)=CH-CH_3$

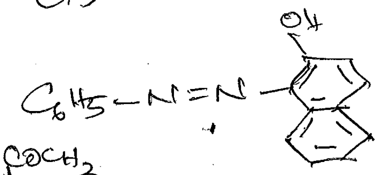
L $CH_3-C(CH_3)(CH_3)-CH_2CH_3$

$11 \times 05 = 55$

a(II)



(b)

(1) 

(2) 

(3) $CH_3-C(=O)-NH-C_6H_5$

(4) $CH_3-C(CH_3)=CH-C(CH_3)_2-CHO$

(5) $CH_3CH_2-C(CH_3)_2-OH$

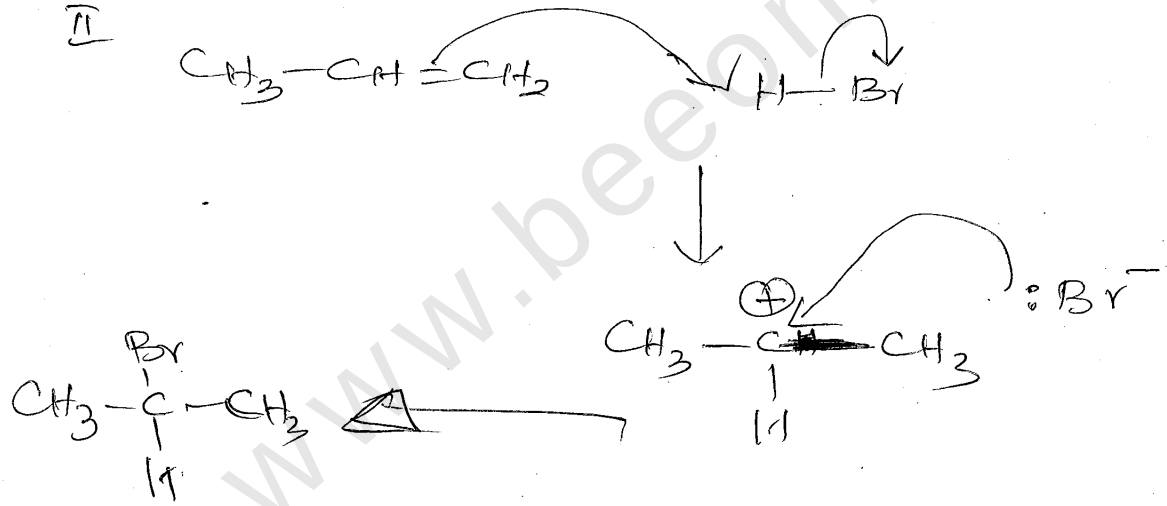
(6) $CH_3-CH(CH_3)-C\equiv C^-Na^+$

$6 \times 03 = 18$

C) I Major Product Minorproduct

$CH_3-CH(Br)-CH_3$ (4) $CH_3CH_2CH_2CH_2Br$ (4)

II



Stability: $CH_3CH_2\overset{+}{C}H_2 < CH_3-\overset{+}{C}H-CH_3$ (9)

OR (Primary carbocation is less stable than that of Secondary carbocation)

Q4 → 100

Part II B

5)

(a) (I) $Ba(OH)_{2(aq)} + H_2SO_{4(aq)} \rightarrow BaSO_4\downarrow + 2H_2O_{(l)}$ — ①

$Ba(OH)_{2(aq)} + 2HCl_{(aq)} \rightarrow BaCl_{2(aq)} + 2H_2O_{(l)}$ — ②

(10)

II $Ba(OH)_{2(aq)} \rightarrow Ba^{2+}_{(aq)} + 2OH^-_{(aq)}$ (10)

0.1 mol

$2 \times 0.1 = 0.2$ mol

According the equation ②

$2H^+_{(aq)} + 2OH^-_{(aq)} \rightarrow 2H_2O_{(l)}$ (05)

0.2 mol   0.2 mol   0.2 mol

amount of $H_2O = 0.2$ mol.

Here only neutralization occurs hence 0.2 mol $OH^-_{(aq)}$ 0.2 mol $H^+_{(aq)}$ reacts to form 0.2 mol $H_2O_{(l)}$ with the release of 11.42 kJ of heat.

For the formation of 1 mol of $H_2O = \frac{11.42\,kJ}{0.2\,mol}$

$= 57.1\,kJ\,mol^{-1}$

$\Delta H_{neu} = -57.1\,kJ\,mol^{-1}$ (15) ∵ energy is released.

According to eq^n ①

Heat energy = Neutralization enthalpy + Heat released during $BaSO_4$ precipitation (precipitation enthalpy) (5)

$= 19.42\,kJ - 11.42\,kJ$

$= 8\,kJ$ (5)

$n_{Ba(OH)_2} = n_{BaSO_4} = 0.1$ mol

$\Delta H_{ppt(BaSO_4)} = -\frac{8\,kJ}{0.1\,mol} = -80\,kJ\,mol^{-1}$ (15)

(IV) According to reaction ① Both neutralization and precipitation takes place in both situations heat is liberated. According reaction ② neutralization of $Ba(OH)_2$ takes place only. Hence in reaction ① higher amount of heat is liberated due to the precipitation of $BaSO_4(s)$ 10

75

5(b)

(I) Real gas molecules cannot colide with the walls of the Vessel with greater momentum. Because of the presence of intermolecular ~~interac~~ interactions they attract each other and would not allow molecules to collide with greater momentum.

But ideal gas does not have such intermolecular interaction hence the pressure exerted by ideal gas molecules on the walls of vessel is greater than real gas. 20

II $\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$ 10

P = Pressure of gas V = volume of gas

n = Total amount of gas R = Universal gas constant

T = absolute Temperature

a = Vander wal's constant depending on the magnitude of intermolecular interactions

b = Vander waal's constant depend on the volume of gas. 10

(III) $PV=nRT$ $n=\frac{PV}{RT}=\frac{1\times10^5\,Nm^{-2}\times41.57\times10^{-3}\,m^3}{8.314\,Nm\,mol^{-1}K^{-1}\times400\,K}$

$=1.25\,mol$ 10 5

$C_2H_{6(g)} + \frac{7}{2}O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)}$

x mol $\quad$ $\frac{7}{2}$ mol

$2C_2H_{6(g)} + 7O_{2(g)} \longrightarrow 4CO_{2(g)} + 6H_2O_{(l)}$

$C_2H_{4(g)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 2H_2O_{(l)}$

y mol $\quad$ 3y mol

Reacted $n_{O_2} = \frac{132g}{32gmol^{-1}} = 4.125mol$

$x + y = 1.25mol$ ——— (1)

$\frac{7}{2}x + 3y = 4.125$

$7x + 6y = 8.25mol$ ——— (2)

$7x + 7y = 1.25 \times 7 = 8.75$ ——— (3)

(3) − (2) ⇒ $y = 0.5mol$

$x = 0.75mol$.

So $n_{C_2H_6} = 0.75mol \quad n_{C_2H_4} = 0.5mol$

20

95 → 150

6 (a)

$Na_2O \quad +1 \quad$ Strong base | Strongly basic

$MgO \quad +2 \quad$ Base

$Al_2O_3 \quad +3 \quad$ Amphoteric

$SiO_2 \quad +4 \quad$ Very weak acid | Very weakly acidic

$P_4O_{10} \quad +5 \quad$ Weak acid | Weakly acidic

$SO_3 \quad +6 \quad$ Acidic

$Cl_2O_7 \quad +7 \quad$ Strong Acid / Strongly acidic

$7 \times 06 = 42$

b)

(b) I $A = ZnS$ $E = S$

$B = ZnCl_2$ $F = SO_2$

$C = H_2S$ $G = H_2O$

$D = [Cr(H_2O)_6]^{3+}$ | $Cr^{3+}_{(aq)}$ $H = Zn(OH)_2$

$8 \times 05 = 40$

II $ZnS + HCl \longrightarrow ZnCl_2 + H_2S$

$3H_2S + Cr_2O_7^{2-} + 8H^+ \longrightarrow 2Cr^{3+} + 3S\downarrow + 7H_2O$

$S + O_2 \longrightarrow SO_2$

$SO_2 + H_2S \longrightarrow 3S\downarrow + 2H_2O$

$ZnCl_{2(aq)} + NaOH_{(aq)} \longrightarrow Zn(OH)_2\downarrow + 2NaCl_{(aq)}$

$Zn(OH)_2 + 2NaOH_{(aq)} \longrightarrow Na_2[Zn(OH)_4] + 2H_2O$

or

Na_2ZnO_2

$ZnCl_2 + 2NH_4OH \longrightarrow Zn(OH)_2 + 2NH_4Cl$

$Zn(OH)_2 + 4NH_3 \longrightarrow Zn(NH_3)_4(OH)_2$ 24

or

$[Zn(NH_3)_4]^{2+} + 2OH^-$

C) (I) $Fe^{2+} \longrightarrow Fe^{3+} + e$ 03

(II) $Cr_2O_7^{2-} + 14H^+ + 6e \longrightarrow 2Cr^{3+} + 7H_2O$ 03

(III) $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$ 03

(IV) $n_{Cr_2O_7^{2-}} = 31 \times 10^{-3}\,dm^3 \times 0.0185\,mol\,dm^{-3}$

$= 0.574\,mol$ 3

$n_{Fe^{2+}} : n_{Cr_2O_7^{2-}} = 6 : 1$ 3

amount of Fe^{2+} in $25 cm^3$ sol^n $= 6 \times 0.574 \times 10^{-3}$ mol
$= 3.45 \times 10^{-3}$ mol. 5

$\therefore$ amount of Fe^{2+} in $250 cm^3$ sol^n $= 3.45 \times 10^{-2}$ mol 4

$W_{Fe} = 3.45 \times 10^{-2}$ mol $\times 56$ g mol^{-1} 5

$= 3.45 \times 10^{-2} \times 56$ g

$= 1.932$ g 5

Percentage of Purity of Fe in iron nail

$= \dfrac{1.932 g}{2.225 g} \times 100\%$ 05

$= 86.83\%$ 05

Q6 → 150

Q7) (a) (i) $CH_2 = CH - \ddot{Cl}:$ ⟷ $\overset{\ominus}{C}H_2 - CH = Cl^{\oplus}$ 10

- According to above resonance structures there is a ~~do~~ double bond character in between C, Cl, therefore the strength of C–Cl bond is higher. hence its unable to break.
- Cabon is sp^2 hybrid state. bond length of that C is low and the bond strength is higher therefore breaking of C–Cl bond is harder. 10

2) $ROH + NaOH \not\rightarrow RO^-Na^+ + H_2O$
Acidity of ROH is lesser than that of H_2O. Compound with lesser acidity cannot produce / result a compound with greater acidity. 8

(II)

(i) $CH_3-C\equiv C-CH_3 \xrightarrow{NH_3/AgNO_3(aq)}$ No change (5)

$CH_3CH_2-C\equiv CH \xrightarrow{NH_3/AgNO_3(aq)}$ white (ppt) $\downarrow$ (5)

(ii) $C_3H_8(g) \xrightarrow{Br_2/CCl_4}$ No change (5)

$C_3H_6(g) \xrightarrow{Br_2/CCl_4}$ Reddish brown of sol^n is decolourized (5)

(iii) $CH_3CH_2CHO \xrightarrow{NH_3/AgNO_3(aq)}$ Silver mirror at the test tube (5)

~~Reddish brown of solution is de~~

$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow{NH_3/AgNO_3(aq)}$ No change (5)

(III) $CH_3CH_2Cl \xrightarrow{KOH/H_2O} CH_3CH_2OH$

$\downarrow$ dil H_2SO_4 / $K_2Cr_2O_7$

CH_3COOH

$CH_3OH \xrightarrow{PCC} HCHO$

$CH_3CH_2Cl \xrightarrow[\text{dry ether}]{Mg} CH_3CH_2MgCl \xrightarrow{①\,HCHO \quad ②\,H_2O} CH_3CH_2CH_2OH$

$CH_3COOH + CH_3CH_2CH_2OH \xrightarrow[\Delta\Delta \text{ (Strong heat)}]{\text{dil } H_2SO_4} CH_3-\overset{\overset{O}{\|}}{C}-OCH_2CH_2CH_3$ (3)

$12 \times 03 = 36$

7) (B) (i) $Cr = 24 = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

(ii) +2, +3, +6

(iii) (i) Blue violet / violet

(ii) $[Cr(H_2O)_6]^{3+}$ hexa aqua chromium(III) ion

(iv) I Blue - green precipitate $Cr(OH)_3$

II Blue - violet $[CrCl_6]^{3-}$

III $Cr^{3+}_{(aq)} + 3NaOH \longrightarrow Cr(OH)_3 \downarrow + 3Na^+_{(aq)}$

$2Cr(OH)_{3(s)} + 3H_2O_{2(aq)} \longrightarrow 2CrO^{2-}_{4(aq)} + 4H_2O_{(l)} + 4H^+_{(aq)}$

Yellow colour solution formed

(V) CrO = Weakly basic +2

Cr_2O_3 = Amphoteric +3

CrO_2 = Weakly acidic +4

CrO_3 = Acidic +6

(VI) CrO_4^{2-} = Yellow $Cr_2O_7^{2-}$ = Orange

(VII) $CrO^{2-}_{4(aq)} + 2H^+_{(aq)} \rightleftharpoons Cr_2O^{2-}_{7(aq)} + H_2O_{(l)}$

$19 \times 03 = 57$

Part I $25 \times 02 = 50$ marks

Part II $Q_1 \rightarrow Q_4 = 400$

Essay (2) = $\frac{600}{1000}$ = 50 marks
$\quad\quad\quad\quad\quad\quad 20$

$Q_7 \Rightarrow \boxed{150}$