FWC-Marking scheme for chemistry

-2017-March

I

A/L 2018

Grade 12

Part-I

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

(25 x 02 = 50 marks)

part IIA 400
part IIB 300
700

Par II 700/14 = 50 mar

Part II -A

(1)(a) (i) F (ii) Cl (iii) C (iv) P (V) Al (VI) C
(06 x 6 = 36 marks)

(b) (i) $H-\ddot{N}=C=\ddot{O}$: — (08)

(ii) $H-\ddot{N}=C=\ddot{O}$: (05) stable (02) has no formal charge (03)
$\longleftrightarrow H-\ddot{\bar{N}}-C\equiv\overset{+}{O}$: (05) unstable (02) oxygen carries a (+)ve charge (03)
$\longleftrightarrow H-\overset{+}{N}\equiv C-\ddot{\bar{O}}$: (05) unstable (02) more atoms (03) carry charges

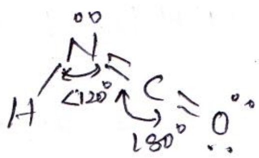
(iii)

	N	C
Electron pairs geometry	- Trigonal planar	Linear
Shape	- Angular	Linear
Hybridization	sp^2	sp

(02 x 6 = 12 marks)

(iv) Polar — (03)

(v) (I) 1s (a.o) + sp^2(h.o)
(II) sp^2(h.o) + sp(h.o)
(III) sp(h.o) + sp(h.o) | 2p (a.o)
(01 x 6 = 06)

(vii) 

Sketch — 03
angles 01 x 2 = (02)

(100 marks)

(02) (a) (i) (A) Ca (B) H_2 (C) $Ca(OH)_2$ (D) CaH_2

(E) $CaCO_3$ (F) $Ca(HCO_3)_2$ (G) CaO (H) CaC_2

(05 x 8 = 40 marks)

(ii) $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$

$Ca + H_2 \longrightarrow CaH_2$

$CaH_2 + 2H_2O \longrightarrow Ca(OH)_2 + 2H_2$

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

$CaCO_3 + CO_2 + H_2O \longrightarrow Ca(HCO_3)_2$

$CaCO_3 \longrightarrow CaO + CO_2$

$CaO + 3C \longrightarrow CaC_2 + CO$

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$ (03 x 8 = 24 marks)

(iii) Flame test : sodium chloride gives a golden yellow (02) flame
(03) potassium chloride gives a violet (lilac) flame (02)

(2(a) 78 marks)

b (i) (I) $2NaNO_3 \longrightarrow 2NaNO_2 + O_2$

(II) $2Mg(NO_3)_2 \longrightarrow 2MgO + 4NO_2 + O_2$

(III) $BaCO_3 \longrightarrow BaO + CO_2$

(IV) $2LiOH \longrightarrow Li_2O + H_2O$

(V) $2NaHCO_3 \longrightarrow Na_2CO_3 + CO_2 + H_2O$ (04 x 5 = 20 marks)

(ii) (I) $2Sr + O_2 \longrightarrow 2SrO$ (II) $Mg + H_2O(g) \longrightarrow MgO + H_2$

(III) $6Li + N_2 \longrightarrow 2Li_3N$ (03 x 3 = 09 marks)

(2(b) - 29 marks]

(03) (a) (i) In a mixture of gases which do not react with each other the total pressure is equal to the sum of the partial pressures of each of the constituent gases — (10 marks)

(ii) (I) P_{He} - partial pressure of He after mixing
P_{Ne} partial pressure of Ne after mixing

$\therefore 4.0 \times 10^5 Nm^{-2} \times 3.0 m^3 = P_{He} \cdot 10.0 m^3$ — (4 + 1)

$P_{He} = 1.2 \times 10^5 Nm^{-2}$ — (4 + 1)

$8.0 \times 10^5 Nm^{-2} \times 7.0 m^3 = P_{Ne} \cdot 10.0 m^3$ — (4 + 1)

$P_{Ne} = 5.6 \times 10^5 Nm^{-2}$ — (4 + 1)

$P_{total} = \underset{(02)}{1.2 \times 10^5 Nm^{-2}} + \underset{(02)}{5.6 \times 10^5 Nm^{-2}} = 6.8 \times 10^5 Nm^{-2}$ (5 + 1)

[a ii I - 30 marks]

(II) Molefraction of He $= \frac{n_{He}}{n_{He} + n_{Ne}} = \frac{P_{He}}{P_{He} + P_{Ne}}$ (03)

$= \frac{1.2 \times 10^5 Nm^{-2}}{6.8 \times 10^5 Nm^{-2}}$ (01+01)

$= 3/17 = 0.17$ –(02)

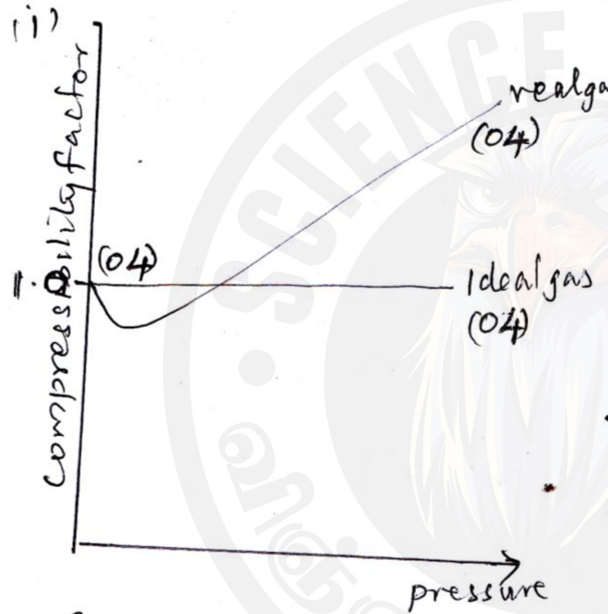
(III) $\frac{P_{He}}{300K} = \frac{P'_{He}}{400K}$ (03)

$P'_{He} = \frac{400}{300} \times 1.2 \times 10^5 Nm^{-2}$ (03+01)

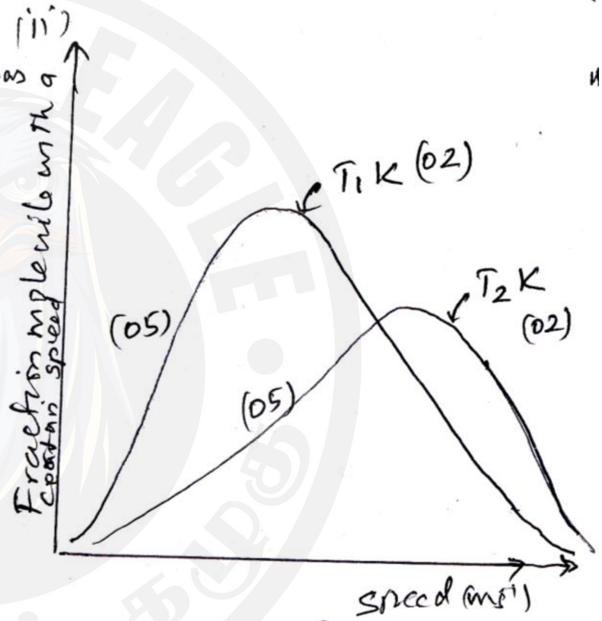
$= 1.6 \times 10^5 Nm^{-2}$ (02+01)

[3a – 60marks]

(b) (i)



(ii)



- Presence of intermolecular attractions among real gaseous molecules – (04)
- Real gas molecules have volume –(04)

- When temperature increased number of molecules that have more energy than activation energy will increase –(06)

(3b – 40marks)

[100marks]

(04) (a)

(i) $\Delta H^{\ominus}_{rxn} = \Sigma \Delta H^{\ominus}_{f(products)} - \Sigma \Delta H^{\ominus}_{f(reactants)}$ — (05)

$= (-635\,kJmol^{-1} + -394\,kJmol^{-1}) - (-1206\,kJmol^{-1})$ — (05)

$= 177\,kJmol^{-1}$ — (05)

(ii) $\Delta S^{\ominus}_{rxn} = \Sigma S^{\ominus}_{(products)} - \Sigma S^{\ominus}_{(reactants)}$ — (05)

$= (40\,JK^{-1}mol^{-1} + 210\,JK^{-1}mol^{-1}) - (93\,JK^{-1}mol^{-1})$ — (05)

$= 157\,JK^{-1}mol^{-1}$ — (05)

(iii) $\Delta G = \Delta H - T\Delta S$ — (10)

(iv) $\Delta G = 177\,kJmol^{-1} - (773\,K \times .157\,kJK^{-1}mol^{-1})$ — (05)

$= +55.64\,kJmol^{-1}$ — (05)

ΔG is positive quantity. — (05)

$\therefore$ Reaction is non-spontaneous at 500 °C

4a [55 marks]

(b) (i) Entropy of a system is a measure of the randomness of the system — (10)

(ii) I - Increase

II - Decrease

III - Increase

IV - Increase

V - Increase (03 x 5 = 15)

(c) (i) $Ca^{+}_{(g)} \longrightarrow Ca^{2+}_{(g)} + e$

(ii) $Mg_{(s)} + Br_{2(l)} \longrightarrow MgBr_{2(s)}$

(iii) $O_{(g)} + e \longrightarrow O^{-}_{(g)}$

(iv) $Br_{2(g)} \longrightarrow 2Br_{(g)}$ (05 x 4 = 20)

No marks if states are incorrect or not given (4b) [45 marks]

[100 marks]

[5]

Part-II B

(01)(a)(i) A reaction in which a single substance reacts to form two products. One product is obtained by the oxidation of original substance and the other by reduction. —(10)

(ii) Oxidation half equation

$MnO_4^{2-} \longrightarrow MnO_4^- + e$ (05)

Reduction half equation

$MnO_4^{2-} + 4H^+ + 2e \longrightarrow MnO_2 + 2H_2O$ (05)

(iii) two examples (05 + 05)

[1a => 30 marks]

(b)(i)(I)

$H_2S \longrightarrow S + 2H^+ + 2e$

$CrO_4^{2-} + 8H^+ + 3e \longrightarrow Cr^{3+} + 4H_2O$

$2CrO_4^{2-} + 3H_2S + 10H^+ \longrightarrow 2Cr^{3+} + 3S + 8H_2O$ —(10)

$\therefore$ Moles of $K_2CrO_4 = \frac{2}{3} = 0.67$ — 05

II $Fe^{3+} + e \longrightarrow Fe^{2+}$

$2Fe^{3+} + H_2S \longrightarrow 2Fe^{2+} + 2H^+ + S$

$2FeCl_3 + H_2S \longrightarrow 2FeCl_2 + S + 2HCl$ — (10)

$\therefore$ moles of $FeCl_3 = 2$ — (05)

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

$2MnO_4^- + 5H_2S + 6H^+ \longrightarrow 2Mn^{2+} + 5S + 8H_2O$ —(10)

$\therefore$ moles of $KMnO_4 = \frac{2}{5}$

$= 0.4$ — (05)

[1b(i) – 45 marks]

(ii)

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

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

$Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$ —(05)

$n_{K_2Cr_2O_7} = 0.016 \times \frac{32.50}{1000}$ mol — (05)

$= 5.2 \times 10^{-4}$ mol

$n_{K_2Cr_2O_7} : n_{Fe^{2+}} = 1 : 6$

$\therefore n_{Fe^{2+}} = 6 \times 5.2 \times 10^{-4}$ mol — (05)

Hence mass of $Fe^{2+} = 56 \times 6 \times 5.2 \times 10^{-4}$ g

$= 0.175$ g — (04)

The percentage by mass of $Fe^{2+} = \frac{0.175}{0.940} \times 100\%$

$= 18.6\%$ —(03)

[1b(ii) – 30 marks]

(c) (i) $Na_2CO_3 \cdot xH_2O + 2HCl \longrightarrow 2NaCl + CO_2 + (x+1)H_2O$ — ①

moles of HCl $= 0.10 \times \frac{48.8}{1000}$ mol

$= 4.88 \times 10^{-3}$ —(03)

Therefore moles of $Na_2CO_3 \cdot xH_2O$ in $25 dm^3$ $= \frac{1}{2} \times 4.88 \times 10^{-3}$

$= 2.44 \times 10^{-3}$ —(03)

$\therefore$ moles of $Na_2CO_3 \cdot xH_2O$ in $1.0 dm^3$ $= \frac{2.44 \times 10^{-3}}{25} \times 1000$

$= 9.76 \times 10^{-2}$ —(03)

$\frac{27.8}{106 + 18x} = 9.76 \times 10^{-2}$ —(03)

$x = 10$ — 03

[1c(i) 20marks]

ii) Mass of C $= 63.36 \times \frac{12}{44}$

$= 17.28 g$ — (03)

mass of H $= 12.96 \times \frac{2}{18}$

$= 1.44 g$ — (03)

moles of C : H

$\frac{17.28}{12}$: $\frac{1.44}{1}$ —(02)

1.44 : 1.44 —(02)

mole ratio $\frac{1.44}{1.44}$ $\frac{1.44}{1.44}$ —(02)

1 : 1 —(02)

Molecular weight of sample $= \frac{18.72}{0.24} = 78$ —(03)

$(CH)_n = 78$

$n = \frac{78}{13} = 6$ —(03)

molecular formula. C_6H_6 —(05)

[1 c(ii) 25marks]

7

02) a (i) $PV = \frac{1}{3} m N \bar{c^2}$ — (20)

P - pressure

V - Volume of gas

m - mass of a gas molecule/particle

N - number of gas molecules/particles.

$\bar{c^2}$ - mean square speed   02 x 5 = 10 marks

(ii) ∵ For an ideal gas

$PV = nRT$ — (1)

$PV = \frac{1}{3} m N \bar{c^2}$ — (2)

For 1 mol gas

(1) & (2) ⇒ $RT = \frac{1}{3} M \bar{c^2}$

$\bar{c^2} = \frac{3RT}{M}$

$\sqrt{\bar{c^2}} = \sqrt{\frac{3RT}{M}}$ — (20)

(iii) $\sqrt{\bar{c^2}} = \sqrt{\frac{3 \times 8.314 \times 300}{4}}$ — (07)

$= 43.25\ ms^{-1}$ (05)

(iv) - Molar mass

- area

- concentration gradient

- temperature

02 x 4 = 08

[2a ⇒ 70 marks]

(b) (i) The enthalpy change that takes place in a chemical reaction where the reactants and products are at specified states is independent of the route of the reaction — (10)

[2b(i) = 10 marks]

(ii) $\frac{3}{2}O_{2(g)} + CO_{(g)} + 2H_{2(g)} \xrightarrow{\Delta H_R^\theta} CH_3OH_{(l)} + \frac{3}{2}O_{2(g)}$

$(-283 + 2 \times -286)\ kJ mol^{-1}$

$-715\ kJ mol^{-1}$

$CO_{2(g)} + 2H_2O_{(l)}$ cycle — (20)

$\Delta H_R^\theta + (-715\ kJ mol^{-1}) = -283 + (-572)\ kJ mol^{-1}$ — (10)

$= -855 + 715\ kJ mol^{-1}$

$= -140\ kJ mol^{-1}$ — (10)

2b(ii) 40 marks

(iii) $K_{(s)} + \frac{1}{2}Cl_{2(g)} \xrightarrow{\Delta H_f^{\theta}} KCl_{(s)}$

$K_{(s)} \xrightarrow{90\ kJmol^{-1}} K_{(g)} \xrightarrow{418\ kJmol^{-1}} K^{+}_{(g)}$

$\frac{1}{2}Cl_{2(g)} \xrightarrow{122\ kJmol^{-1}} Cl_{(g)} \xrightarrow{-348\ kJmol^{-1}} Cl^{-}_{(g)}$

$K^{+}_{(g)} + Cl^{-}_{(g)} \xrightarrow{-718\ kJmol^{-1}} KCl_{(s)}$

cycle - (15)

$\Delta H_f^{\theta} = 90 + 418 + 122 + (-348) + (-718)\ kJmol^{-1}$ - (10)

$= -436\ kJmol^{-1}$ - (05)

[2b(ii) 30 marks]

[2b ⇒ 80 marks]

(3)
a (i) Mg - (10)

ii $1s^2 2s^2 2p^6 3s^2$ - (10)

(iii) $2Mg + O_2 \longrightarrow 2MgO$ - (05)

$3Mg + N_2 \longrightarrow Mg_3N_2$ - (05)

(iv) NH_3 - (10)

(v) $Mg + 4HNO_3 \longrightarrow Mg(NO_3)_2 + 2NO_2 + 2H_2O$ - (10)

(3a ⇒ 60 marks)

(vi) • Manufacture of alloys • Flash light powders • Fireworks (Mg powder) • Manufacture of batteries (05+05)

(b) (i) Group 1 and 2 metals both have relatively weak metallic bonding. Metallic bonding in group 1 is weaker than that in group 2 as group 1 metals only donate 1 electrons per atom into the delocalized sea of electrons where as group 2 metals donate 2 outer shell electron per atom (10)

(3b ⇒ 40 marks)

(ii) Be - (10)

(iii) I $Ba(OH)_2$ - (05)

(II) $CaSO_4$ - (05)

(iv) • Larger cation so less polarising power (05)

• Lower cation charge so less polarising power (05)

(c) (i) NaOH - Base

$Mg(OH)_2$ - Base

$Al(OH)_3$ amphoteric

H_2SiO_3 - acid

H_3PO_4 - acid

H_2SO_4 - acid

$HClO_4$ - acid

(03×14 = 42)

(3c 50 marks)

(ii) $Al(OH)_3 + 3HCl \rightarrow AlCl_3 + 3H_2O$ - (04)

$Al(OH)_3 + NaOH \rightarrow NaAl(OH)_4$ - (04)