FWC-Marking scheme for chemistry

-2017-March

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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 (E)	19 - 2	24 - 3
5 - 2	10 - 5	15 - 2	20 - 3	25 - 1

(25 x 02 = 50 marks)

part II A 400
part II B 300
700

Par II 7
14
= 50 ma

Part II -A

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

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

(ii) $H-\ddot{N}=C=\underset{\cdot\cdot}{\ddot{C}} \longleftrightarrow H-\underset{\cdot\cdot}{\overset{-}{\ddot{N}}}-C\equiv\overset{+}{O}: \longleftrightarrow H-\overset{+}{N}\equiv C-\underset{\cdot\cdot}{\overset{-}{\ddot{O}}}:$

(05)	(05)	(05)
stable (02)	unstable (02)	unstable (02)
has no formal charge (03)	oxygen carries a (+)ve charge (03)	more atoms carry charges (03)

(iii)

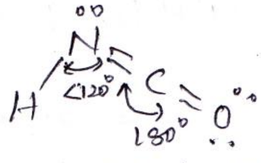
	N	C
Electronpairs geometry	- Trigonal planar	Linear
shape	- Angular	Linear
Hybridization	sp^2	SP

(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)

(vi)



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

(05x8 = 40 marks)

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

$Ca + H_2 \longrightarrow CaH_2$

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

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

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

$CaCO_3 \longrightarrow CaO + CO_2$

$CaO + 3C \longrightarrow CaC_2 + CO$

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$ (03x8 = 24 marks)

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

potassium chloride gives a violet (lilac) flame (02)

(2(a) 71 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)

$P_{total} = 1.2 \times 10^5 Nm^{-2} + 5.6 \times 10^5 Nm^{-2} = 6.8 \times 10^5 Nm^{-2}$

(02) (02) (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)

$= \quad = \frac{1.2\times10^{5}\,Nm^{-2}}{6.8\times10^{5}\,Nm^{-2}}$ (01+01)

$= 3/17 = 0.17$ -(02)

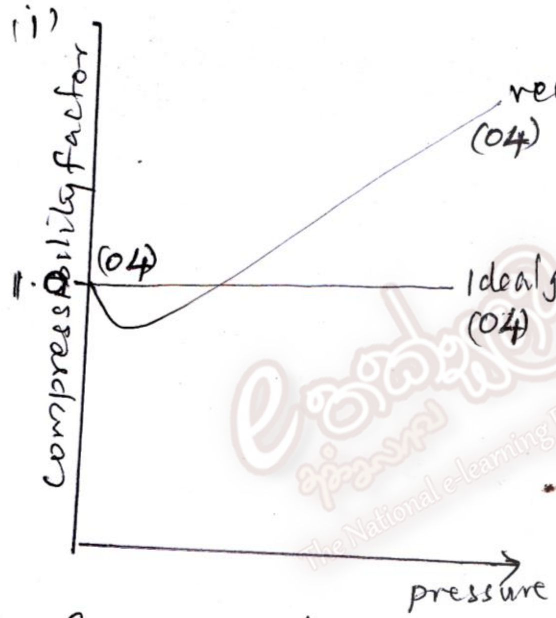
(III) $\frac{P_{He}}{300K} = \frac{P'_{He}}{400K}$ (03)

$P'_{He} = \frac{400}{300}\times1.2\times10^{5}\,Nm^{-2}$ (03+01)

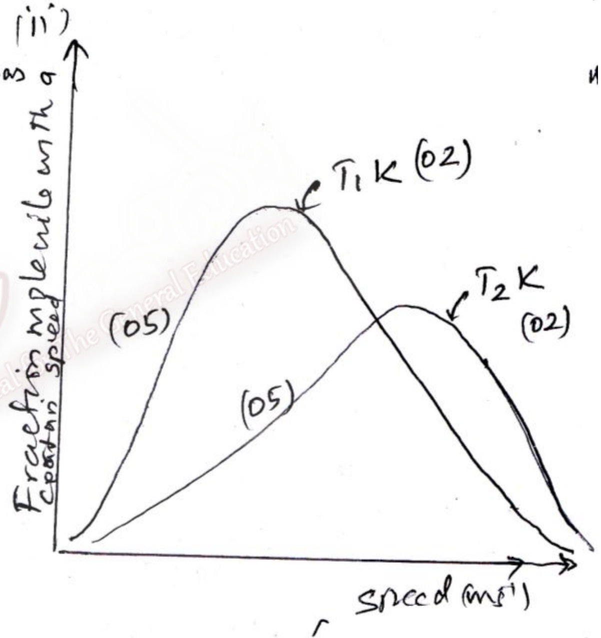
$= 1.6\times10^{5}\,Nm^{-2}$ (02+01)

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

$= +55.64 kJmol^{-1}$ — (05)

ΔG is positive quantity. —(05)

$\therefore$ Reaction is non-spontaneons 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]

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

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

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

∴ 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)

∴ 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)

∴ moles of $KMnO_4 = \frac{2}{5}$

$= 0.4$ — (05)

[1b(i) – 45 marks]

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

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

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

∴ $n_{Fe^{2+}} = 6 \times 5.2 \times 10^{-4}$ 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 $Fe^{2+} = \frac{0.175}{0.940} \times 100\%$

$= 18.6\%$ —(05) [1b(ii) – 30 marks]

(c) (i) $Na_2CO_3 \cdot + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$ — 6

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 $25dm^3 = \frac{1}{2} \times 4.88 \times 10^{-3}$

$= 2.44 \times 10^{-3}$ — (03)

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

$= 9.76 \times 10^{-2}$ — (03)

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

$x = 10$ — 03

[1 c(i) 20marks]

ii) Mass of C $= 63.36 \times 12/44$

$= 17.28g$ — (03)

Mass of H $= 12.96 \times 2/18$

$= 1.44g$ — (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)

$(CH)_n = 78$

$n = 78/13 = 6$ — (03)

molecular formula. C_6H_6 — (05)

[1 c(ii) 25marks]

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 × 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

$① \& ② \Rightarrow RT = \frac{1}{3} M \bar{c^2}$

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

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

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

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

(iv) - Molarmass

- area
- concentration gradient
- temperature

02×4 = 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)

$$\begin{tikzcd}
\frac{3}{2}O_{2(g)} + CO_{(g)} + 2H_{2(g)} \arrow[r, "\Delta H_R^{\ominus}"] \arrow[dr, "(-283 + 2\times -286)\ kJmol^{-1}"'] & CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \arrow[d, "-715\ kJ\ mol^{-1}"] \\
 & CO_{2(g)} + 2H_2O_{(l)}
\end{tikzcd}$$

cycle —(20)

$\Delta H_R^{\ominus} + (-715\ kJmol^{-1}) = -283 + (-572)\ kJmol^{-1}$ —(10)

$= -855 + 715\ kJmol^{-1}$

$= -140\ kJmol^{-1}$ —(10)

2b(ii) 40 marks

(iii)

$$\begin{tikzcd}
K_{(s)} \arrow[d, "90 kJmol^{-1}"] & + & \frac{1}{2}Cl_{2(g)} \arrow[r, "\Delta H_f^\ominus"] \arrow[d, "122 kJmol^{-1}"] & KCl_{(s)} \\
K_{(g)} \arrow[d, "418 kJmol^{-1}"] & & Cl_{(g)} \arrow[d, "-348 kJmol^{-1}"] & \\
K^+_{(g)} & & Cl^-_{(g)} \arrow[uur, bend right, "-718 kJmol^{-1}"'] &
\end{tikzcd}$$

cycle - (15)

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

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

[2b(ii) 30marks]

[2b→50marks]

(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)

(3a→60marks)

(iv) NH_3 —(10)

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

(vi) • Manufacture of alloys • Flashlight 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→40marks)

(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)

(3c 50marks)

(c)(i) NaOH. - Base
$Mg(OH)_2$ - Base
$Al(OH)_3$ amphoteric
H_2SiO_3 - acid
H_3PO_4 - acid
H_2SO_4 - aci
$HClO_4$ - a
(03×14 = 4

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

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

(5)