வடமாகாணக் கல்வித் திணைக்களத்துடன் இணைந்து
தொண்டைமானாறு வெளிக்கள நிலையம் நடாத்தும்
தவணைப் பரீட்சை, மார்ச் - 2020
Conducted by Field Work Centre, Thondaimanaru
In Collaboration with Provincial Department of Education
Northern Province
Term Examination, March - 2020

FWC

தரம் :- 12 (2021)	இரசாயனவியல் – I	

பகுதி – I

01) 1	10) 3	19) 5
02) 2	11) 5	20) 2
03) 3	12) 5	21) 1
04) 4	13) 3	22) 2
05) 5	14) 5	23) 1
06) 5	15) 4	24) 1
07) 4	16) 3	25) 2
08) 3	17) 2	
09) 4	18) 1	

(25 x 2 = 50 புள்ளிகள்)

Part I - 25 x 2 = 50 புள்ளிகள்

Part – II 50 புள்ளிகள்

100 புள்ளிகள்

Part - II 4 x 100 = 400

2 x 150 = 300

700

700 ÷ 14 = 50 புள்ளிகள்

G.C.E. A/L Examination March - 2020

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education Northern Province.

FWC

Chemistry II - A	Grade :- 12 (2021)	

Part – II

Structure questions - A

❖ **Answer all the questions.**

01. a) Fill in the blanks for the following questions.

(i) Out of the elements N, O, F which element has the highest first ionization energy? ....F........

(ii) Out of the three cations Na^+, Al^{3+}, Ca^{2+} the ion having the smallest ionic radius. ....Al^{3+}........

(iii) Out of the molecules H_2S, SO_2, H_2O which one has the highest bond angle? ....SO_2........

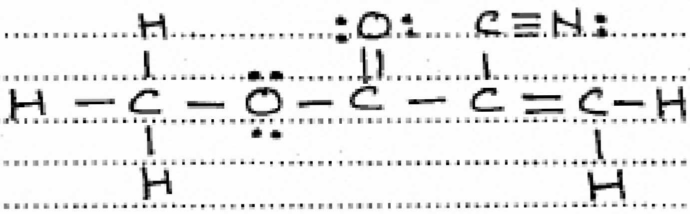
(iv) Of the elements C, S, Br which one has the highest electro negativity? ....Br........

(v) Out of Mn Co^{2+}, Fe^{3+} which ion has five unpaired electrons? ....Fe^{3+}........

[05 x 5 = 25 Marks]

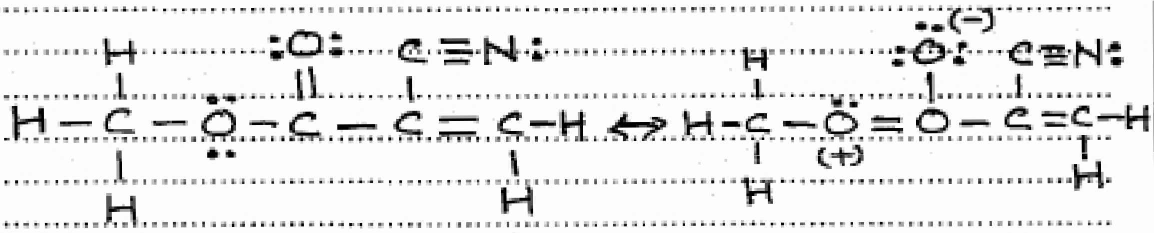
b) The following questions are based the molecule methyl 2 – cyanoacrylate [MCA]. Given below it's basic structure.

(i) Draw the most acceptable Lewis structure of the MCA molecule.



[07 Marks]

(ii) Draw the possible resonance structures of MCA.



[10 Marks]

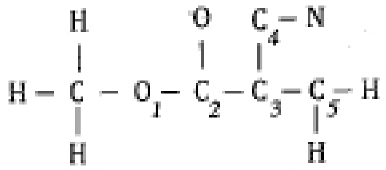
(iii) On the basis of the Lewis structures of MCA molecule drawn in (i) above complete the table given below. .

I. VSEPR pair around the atom

II. Geometry of electron pairs around the atom

III. Shape around the atom

IV. hybridization of the atom



	O_1	C_2	C_3	C_4
I. VESPR pairs	4	3	3	2
II. Geometry of electron pair	Tetrahedral	Triangular planer	Triangular planer	Linear
III. shape	Angular	Triangular planer	Triangular planer	Linear
IV. hybridization	sp^3	sp^2	sp^2	sp

[16 Marks]

(iv) In the Lewis structure given in (i) above identify the atom / hybrid orbitals related to the σ bond formation given below. [as shown in atom number in question (iii)]

I. $O_1 - C_2$:- O_1 ......sp^3 h.o...... C_2 ......sp^2 h.o......

II. $C_2 - C_3$:- C_2 ......sp^2 h.o...... C_3 ......sp^2 h.o......

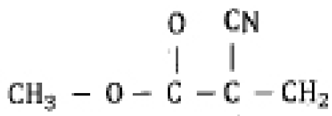
III. $C_3 - C_4$:- C_3 ......sp^2 h.o...... C_4 ......sp h.o......

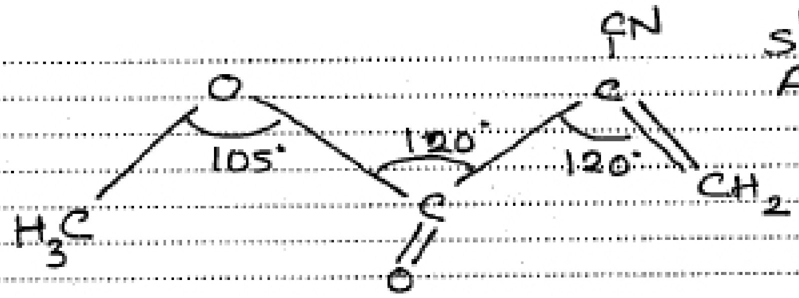
IV. C_4 – N :- C_4 ......sp h.o...... N ......2p A.O......

V. $C_3 - C_5$:- C_3 ......sp^2 h.o...... C_5 ......sp^2 h.o......

[10 Marks]

(v) Consider the MCA molecule as given below and draw the approximate shape indicating bond angles.





Shape - 4
Angle - 3

[07 Marks]

c) In the statements given below state whether they are true or false .

I. NO_2^- is more stable than NO_4^{3-} (True)

II. Melting point of KI is higher than that of KI (False)

III. The kinetic energy of particles of ideal gas is directly proportional to absolute temperature (False)

IV. At room temperature entropy of 1 mol CO_2 is higer than that of 1 mol of water (True)

V. All the metals of S- block readily react with water (False)

[05 x 5 = 25 Marks]

100

02. a) A, B are metals of S – block with water A reacts slowly and B reacts vigorously to produce solutions C and D respectively and a colourless gas E. Both A and B reacted with N_2 gas to produce solids F and G respectively. F and G reacted with water solutions gives C and D respectively and a gas H which changed litmus from red to blue. A and B have the highest and the lowest first ionization energies in their group. These metal A and B produced Crimson red and yellow- green flames in the flame test.

(i) Identify A – H and write the formulae

A - Li		E - H_2	
B - Ba		F - Li_3N	
C - LiOH		G - Ba_3N_2	
D - $Ba(OH)_2$		H - NH_3	

[02 x 8 = 16 Marks]

(ii) Write the electro configuration of A in the form $1S^2, 2S^2$ ……………………

A :- $1S^2 2S^1$

[04 Marks]

(iii) Write the balanced equation for the reaction of A, B with water (Use real symbols) .

A :- $2Li + 2H_2O \longrightarrow 2LiOH + H_2$

B :- $Ba + 2H_2O \longrightarrow Ba(OH)_2 + H_2$

[05 x 2 = 10 Marks]

(iv) Write balanced chemical equations for the reactions of F and G with water

F :- $Li_3N + 3H_2O \longrightarrow 3LiOH + NH_3$

G :- $Ba_3N_2 + 6H_2O \longrightarrow 3Ba(OH)_2 + 2NH_3$

[05 x 2 = 10 Marks]

(v) Write balanced chemical equation for the thermal decomposition of the nitrate of A.

$4LiNO_3 \longrightarrow 2Li_2O + 4NO_2 + O_2$

[05 Marks]

(vi) When CO_2 gas is passed through D, white precipitate is obtained. Write balanced equation

$Ba(OH)_2 + CO_2 \longrightarrow BaCO_3 + H_2O$

[05 Marks]

(vii) Which of the salts of A are insoluble in water?

LiF, Li_2CO_3, Li_3PO_4 [06 marks]

~~[06 Marks]~~

(viii) Write the name / s of the group to which A and B belong

A - alkali metals B - alkaline earth metals

[04 Marks]

(ix) What is the purpose of using conc. HCl in flame test?

Chlorides are highly volatile and hence they show colours in flame test. used to clean pt

[05 Marks]

(x) Some metals / their salts belonging to S – block do not show any colour in flame test state reason.

when subjected to flame test, the electrons are excited to higher energy level and then release energy which does not fall in the visible region and hence no colour

[05 Marks]

(xi) What are the metals that are used for flame test.

pt / Ni-Cr (Nichrome)

[05 Marks]

(xii) What would you observe if salts containing same type of cation and different types of anions are used in flame test?

Both the salts show the same colour

[05 Marks]

b) The following compound are contained in test tubes labelled from A to E but not in the order.

$Pb(NO_3)_2$, $(NH_4)_2CO_3$, $MgSO_4$, $BaCl_2$, Na_2S

The tests performed on the above compounds to identify them and the observations are given below.

Compound	Test and observation
A	On heating produced three gaseous products
B	With dilute HCl produced a gas with bad odour
C	When $KI_{(aq)}$ added, produced yellow precipitate
D	With both $NaOH_{(aq)}$ and $NH_4OH_{(aq)}$ produced precipitate.
E	No precipitate with $NaOH_{(aq)}$

Identify the compounds from A to E .

A - $(NH_4)_2CO_3$

B - Na_2S

C - $Pb(NO_3)_2$

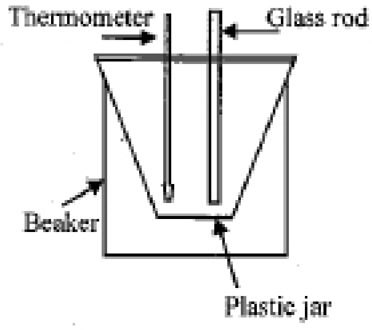
D - $MgSO_4$

E - $BaCl_2$

[05 x 4 = 20 Marks]

100

03. The apparatus shown in the diagram is used to find the enthalpy of neutralization of NaOH and HCl. At 30^0 C 500 cm^3 of 1 $moldm^{-3}$ HCl solution and 500 cm^3 of 1 $moldm^{-3}$ aqueous solution of NaOH mixed and the temperature of the mixture rose to 36.8^0C. Density of water and the specific heat capacity are $1.00\ gcm^{-3}$ *and* $4.20 J g^{-1} K^{-1}$ respectively.



(i) Calculate the heat evolved in the above experiment

$q = mS\Delta T$ —(2)

$= 1000 cm^3 \times 1 g cm^{-3} \times 4.2 J g^{-1} K^{-1} \times (36.8 - 30) K$ ←(3)

$= 28.56 \times 10^3$

$= 28.56\ kJ$ —(5)

[10 Marks]

(ii) Is the above reaction exothermic or endothermic? Give reason

Exothermic reaction, heat evolved or rise in temperature

[04 Marks]

(iii) What is the number of moles of $H_2O_{(l)}$ produced in the above reaction?

$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$ —(3)

initial mol $1 mol dm^{-3} \times 500 \times 10^{-3}$ $1 mol dm^{-3} \times 500 \times 10^{-3} dm^{3}$ — — —(3)

$n_{H_2O} = 0.5\ mol$ —(4)

[10 Marks]

(iv) Using the data given in the above experiment. Find the enthalpy change of neutralization of the reaction between NaOH and HCl

Heat evolved when forming 0.5 mol of H_2O = 28.56 kJ

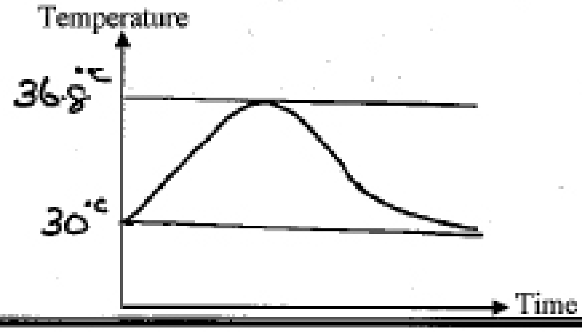
Heat evolved when forming 1 mol of H_2O = 57.12 kJ

$\Delta H_{neu} = -57.12\ kJ mol^{-1}$

[10 Marks]

(v) By drawing the curve show how the temperature of the system (solution) changes with time .

Note :- Finally the temperature returns to 30^0C



[10 Marks]

(vi) Explain, why plastic vessel is used instead of metallic vessel

Metals are good conductors of heat
Plastics are poor conductor of heat
and have very low heat capacity

[05 Marks]

(vii) At the beginning of the experiment if the initial temperatures of HCl and NaOH are $t_1{}^0C$ and $t_2{}^0C$ respectively, what would be the initial temperature you would use in your calculation

$\frac{t_1{}^{\circ}C + t_2{}^{\circ}C}{2}$

[05 Marks]

(viii) State the assumptions you had used in the above experiment

specific heat capacity of solution = specific heat capacity of water
density of solution = density of water
heat lost to environment is negligible
plastic vessel did not absorb heat.

[06 Marks]

(ix) In the above experiment instead of HCl if CH_3COOH of same volume and concentrations are used will you get the same value you got in (iv) above. state reason.

No. Since CH_3COOH is a weak acid
it absorbs some energy for its
ionisation and heat/energy released
from reaction is lesser.

[10 Marks]

(x) If the above experiment is done using $500\ cm^3$ of $0.5\ moldm^{-3}$ H_2SO_4 and $500\ cm^3$ of $0.5\ moldm^{-3}$ $Ba(OH)_2$ will the final temperature be equal / more / less than 36.8^0C. Give reason

More, Since $BaSO_4$ is precipitated
during reaction there will be
more energy released, which causes
the temperature of resulting solution
higher than $36.8^{\circ}C$

[10 Marks]

(xi) At 30^0C ΔS for the reaction between NaOH and HCl is $80.6\ JK^{-1}mol^{-1}$. Using the enthalpy value obtained in (iv) above, calculate ΔG for the reaction between NaOH and HCl in $kJmol^{-1}$ (at 30^0C)

$\Delta G = \Delta H - T\Delta S$ — (3)

$= -57.12\ kJmol^{-1} - 303\ K \times 80.6 \times 10^{-3}\ kJ\ K^{-1}mol^{-1}$

$= -57.12 - 24.42$ (3)

$= -81.54\ kJmol^{-1}$ (3+1)

[10 Marks]

(xii) When temperature increases, what will happen to the value of ΔG in the initial experiment give reason.

ΔG will be higher in negative value
ΔH is negative and ΔS is positive. Therefore
when T increases $T\Delta S$ will increase negatively.
Therefore this will be added to ΔH and
increase more negatively.

[10 Marks]

100

04. a) (i) Write the molecular kinetic equation and identify the symbols

$PV = \frac{1}{3} mN\overline{c^2}$

P – Pressure of gas
V – Volume of gas
m – mass of one molecule
N – number of molecules
$\overline{c^2}$ – mean square velocity

[10 Marks]

(ii) Using ideal gas equation and the above equation prove that $\sqrt{\overline{C^2}} = \sqrt{\frac{3RT}{M}}$ M – molar mass

$PV = nRT$

$nRT = \frac{1}{3} mN\overline{c^2}$

$nRT = \frac{1}{3} w\overline{c^2}$

$3RT = \frac{w}{n}\overline{c^2}$

$\overline{c^2} = 3RT \times n/w$

$= \frac{3RT}{M}$

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

[10 Marks]

(iii) Using the above formula at 320 K calculate the root mean square velocity of $O_{2(g)}$ at 320 K
(O – 16)

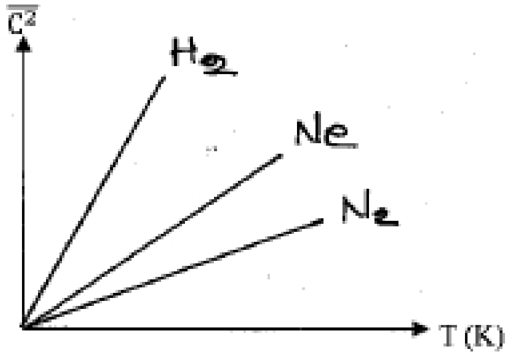
$\sqrt{\overline{c^2}} = \sqrt{\frac{3 \times 8.314\ Jmol^{-1}K^{-1} \times 320\ K}{32 \times 10^{-3}\ kgmol^{-1}}}$

$= 500\ ms^{-1}$

[05 Marks]

(iv) Draw the graph of $\overline{C^2}$ Vs t (K) for the gases $H_{2(g)}$, $Ne_{(g)}$, $N_{2(g)}$ [gases behave idealy]

(H – 1, Ne – 20, N – 14)

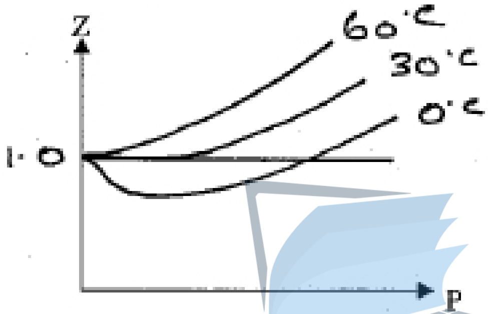


[05 Marks]

(v) If the Boyles temperature of A is 30^0C

I. 60^0C II. 30^0C III. 0^0C

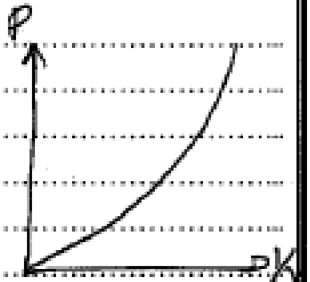
For gas A draw the graph of compressibility factor (Z) Vs pressure (P).



[10 Marks]

(vi) For a gas, of which, the molar mass is not known, how would you find out, whether the gas deviates from ideal behaviour.

A certain amount of gas is taken and at a fixed temperature the volume is Changed and the Corresponding pressure is measured. A graph is drawn with P against 1/V. since the graph is not a straight line passing through the origin it follows that the gas deviates from ideal



[10 Marks]

b) (i) Write balanced chemical equations for the following enthalpy changes .

I. Standard enthalpy of combustion of $C_6H_{6(l)}$

$C_6H_{6(l)} + \frac{15}{2} O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(l)}$

II. Standard enthalpy of formation of $C_3H_{8(g)}$

$3C_{(s, graphite)} + 4H_{2(g)} \longrightarrow C_3H_{8(g)}$

III. Standard enthalpy of dissociation of lattice of $Al_2O_{3(s)}$

$Al_2O_{3(s)} \longrightarrow 2Al^{3+}_{(g)} + 3O^{2-}_{(g)}$

IV. Standard enthalpy of solvation of $NaCl_{(s)}$

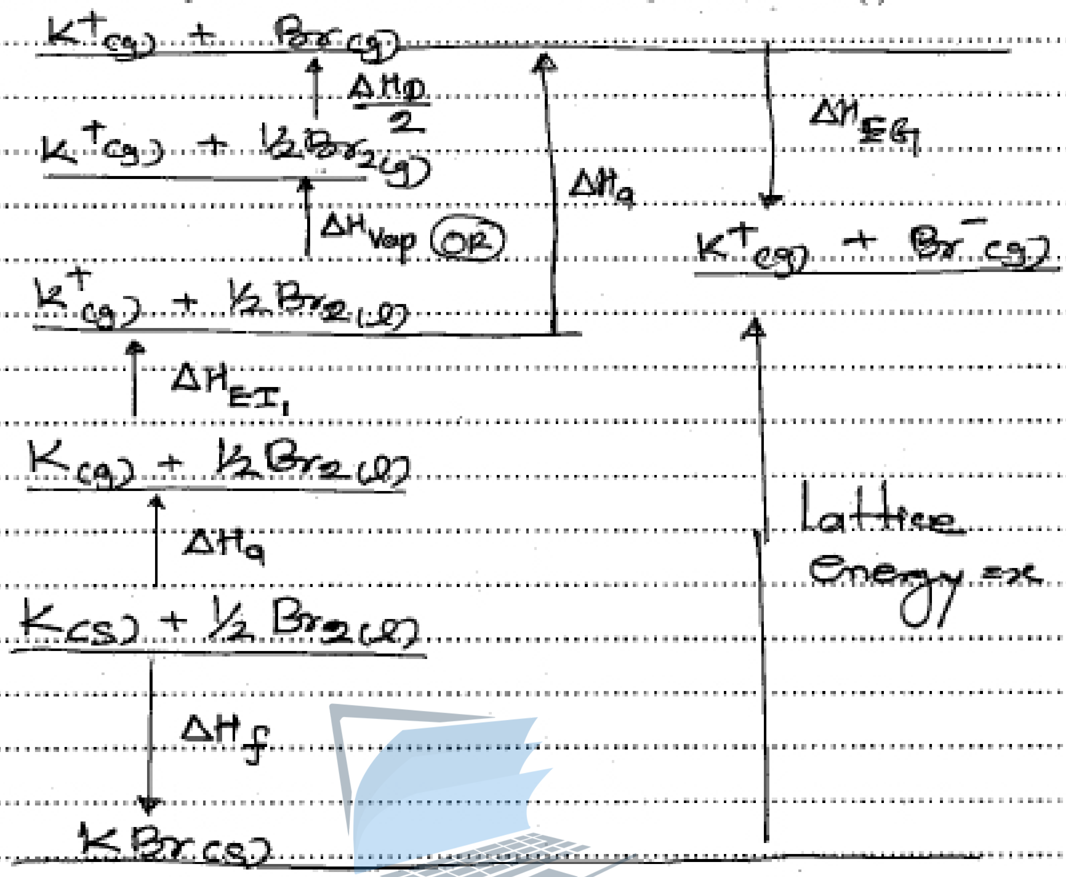
$NaCl_{(s)}$ + water $\longrightarrow NaCl_{(aq)}$

V. Standard enthalpy of atomization of bromine

$\frac{1}{2} Br_{2(l)} \longrightarrow Br_{(g)}$

[25 Marks]

VI. Draw Born – Haber cycle for the calculation of lattice enthalpy change of $KBr_{(s)}$



[20 Marks]

Hess Law

$$\Delta H_a + \Delta H_{EI_1} + \Delta H_{vap} + \frac{\Delta H_D}{2} + \Delta H_{EG} = \Delta H_f + x$$

x Can be determined.

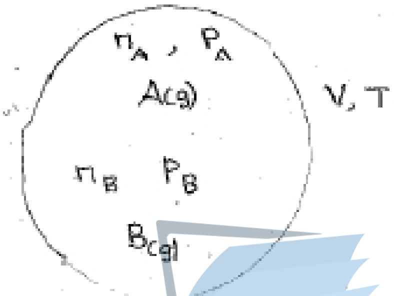
100

Part B

5) (a) I. All the gases which satisfy the ideal gas equation, $PV = nRT$, at all temperatures and pressures are ideal gases. — (3)

II. 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 at the same temperature. — (5)

III. Answer — (5)



$$PV = nRT$$

For gas A, $P_A V = n_A RT$ — ①

gas B, $P_B V = n_B RT$ — ②

For the system, $P_T V = (n_A + n_B)RT$ — ③

① + ② $\Rightarrow$ $V(P_A + P_B) = (n_A + n_B)RT$ — ④

$\frac{(3)}{(4)} \Rightarrow \frac{P_T}{P_A + P_B} = 1$ — (10)

$$\boxed{P_T = P_A + P_B}$$

b) I A $\Rightarrow$ $n_{He} = \frac{4g}{4g\,mol^{-1}} = 1\ mol$ — (5)

B $\Rightarrow$ $n_{Ne} = \frac{40g}{20g\ mol^{-1}} = 2\ mol$.

II <u>A</u> $PV = nRT$

$P \times 4.157 \times 10^{-3}\ m^3 = 1mol \times 8.314\ J\,mol^{-1}\,K^{-1} \times 300K$

$P = 6 \times 10^5\ Pa$ — (5)

<u>B</u> $P \times 8.314 \times 10^{-3}\ m^3 = 2\ mol \times 8.314\ J\,mol^{-1}\,K^{-1} \times 400K$

$P = 8 \times 10^5\ Pa$ — (5)

iii) A $PV = nRT$

$P^{1} \times 4.157 \times 10^{-3}\,m^{3} = n_1 \times 8.314\,J\,mol^{-1}\,K^{-1} \times 300\,K$

$n_1 = \dfrac{P^{1} \times 10^{-3}}{600}$ —— 5

B $P^{1} \times 8.314 \times 10^{-3}\,m^{3} = n_2 \times 8.314\,J\,mol^{-1}\,K^{-1} \times 400\,K$

$n_2 = \dfrac{P^{1} \times 10^{-3}}{400}$ —— 5

$n_1 + n_2 = 3\,mol$

$\dfrac{P^{1} \times 10^{-3}}{600} + \dfrac{P^{1} \times 10^{-3}}{400} = 3$ —— 5

$10P^{1} \times 10^{-3} = 3 \times 24 \times 10^{2}$

$P^{1} = 7.2 \times 10^{5}\,Pa$ —— 5

iv) $M = X_{He} \times M_{He} + X_{Ne} \times M_{Ne}$

$= \frac{1}{3} \times 4\,g\,mol^{-1} + \frac{2}{3} \times 20\,g\,mol^{-1}$

$= \frac{44}{3}\,g\,mol^{-1}$ —— 5

$= 14.67\,g\,mol^{-1}$

v) $PV = nRT$

$PV = \dfrac{m}{M} RT$

$P = \dfrac{m}{V} \cdot \dfrac{RT}{M}$

$P = d \dfrac{RT}{M}$

$d = \dfrac{PM}{RT}$ —— 5

To the system at 27°C

$P^{11} (4.157 + 8.314) \times 10^{-3}\,m^{3} = 3\,mol \times 8.314\,J\,mol^{-1}\,K^{-1} \times 300\,K$

$P^{11} = 6 \times 10^{5}\,pa.$ —— 5

$d = \dfrac{6 \times 10^{5}\,Pa \times \frac{44}{3} \times 10^{-3}\,kg\,mol^{-1}}{8.314\,J\,mol^{-1}\,K^{-1} \times 300\,K}$

$= 3.53\,kg\,m^{-3}$ —— 5

80

c) I Systems where there is no exchange of matter across the boundary but exergy is exchanged are called closed systems. —— 10

II(i) The enthalpy change that occurs when gaseous species in the standard state is converted into gaseous compounds by breaking one mole of bonds. —— 10

(ii) This is the enthalpy change that occurs when a mole of gaseous ions dissolve in water to produce a solution of concentration $1\ mol\ dm^{-3}$ —— 10

III

$$C_2H_4(g) + 3O_2(g) \xrightarrow{\Delta H^{\ominus}_{rxn}} 2CO_2(g) + 2H_2O(l)$$

$2 \times 41\ kJmol^{-1}$ ($2H_2O(l) \rightarrow 2H_2O(g)$)

$610\ kJmol^{-1} + 4 \times 412\ kJmol^{-1}$

$3 \times 495\ kJmol^{-1}$

$4 \times 750\ kJmol^{-1}$

$4 \times 460\ kJmol^{-1}$

$$2C(g) + 4H(g) + 6O(g)$$

$6 \times 5 = 30$

By Hess's law

$$\Delta H^{\ominus}_{rxn} + 4 \times 750\ kJmol^{-1} + 2 \times 41\ kJmol^{-1} + 4 \times 460\ kJmol^{-1}$$

$$= 610\ kJmol^{-1} + 4 \times 412\ kJmol^{-1} + 3 \times 495\ kJmol^{-1}$$ —— 5

$$\Delta H^{\ominus}_{rxn} = 3743 - 4922$$

$$= -1179\ kJmol^{-1}$$ —— 5

70

6) (a) I. X – Na Y – H_2 — (10)

II. P – NaH R – Na_2O (NaO_2), Q – Na_2O_2 (NaO_2) — (15)

III. $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

$2Na + 2HCl \longrightarrow 2NaCl + H_2$ — (10)

IV. $NaH + H_2O \longrightarrow NaOH + H_2$ — (5)

V. $2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$ — (10)

$Na_2CO_3 + CO_2 + H_2O \longrightarrow 2NaHCO_3$

VI. Na_2CO_3 — (5)

VII. White precipitate — (5)

$MgCl_{2(aq)} + 2NaOH_{(aq)} \longrightarrow Mg(OH)_{2(s)}\downarrow + 2NaCl_{(aq)}$ — (5)

VIII. Sea water / Rock salt — (5)

IX. Sodium lamp (any other suitable) — (5)

X. $LiNO_3 < NaNO_3 < KNO_3 < RbNO_3 < CsNO_3$

Anion not changed, charge on cation the same. — (15)

radius of cation $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

hence polarising ability $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Since polarising ability reduces ionic character increases

∴ dissociation temperature increases.

(90)

b) I. oxidation : $C_2O_4^{2-} \longrightarrow 2CO_2 + 2e$ — (5)

Reduction $Cr_2O_7^{2-} + 6e + 14H^+ \longrightarrow 2Cr^{3+} + 7H_2O$ — (5)

II. $Cr_2O_7^{2-} + 3C_2O_4^{2-} + 14H^+ \longrightarrow 6CO_2 + 2Cr^{3+} + 7H_2O$ — (5)

III. $n_{K_2Cr_2O_7} = \dfrac{5.88\,g}{294\,g\,mol^{-1}}$

$= 2 \times 10^{-2}$ mol — (3)

$n_{Na_2C_2O_4} = 0.3\ mol\,dm^{-3} \times 100 \times 10^{-3}\ dm^3$

$= 3 \times 10^{-2}$ mol. — (3)

$\dfrac{n_{Cr_2O_7^{2-}}}{n_{C_2O_4^{2-}}} = \dfrac{1}{3}$ — (3)

$3n_{Cr_2O_7^{2-}} = n_{C_2O_4^{2-}}$

number of moles of $Na_2C_2O_4$ needed to completely react with $K_2Cr_2O_7 = 6 \times 10^{-2}$ mol > number of moles of $Na_2C_2O_4$ reacted.

Number of moles of $K_2Cr_2O_7$ needed to completely react with $Na_2C_2O_4 = 1 \times 10^{-2}$ mol < number of moles of $K_2Cr_2O_7$ — 3

Hence limiting reagent is $Na_2C_2O_4$ — 3

iv $\frac{n_{CO_2}}{n_{C_2O_4^{2-}}} = \frac{6}{3}$

$n_{CO_2} = 2 \times 3 \times 10^{-2}$ mol — 5

$= 6 \times 10^{-2}$ mol

v At STP volume of 1 mol of CO_2 = 22.414 dm^3

$\therefore$ at STP volume of 6×10^{-2} mol $CO_2 = \frac{22.414 \, dm^3}{1 \, mol} \times 6 \times 10^{-2}$ mol

$= 1.345 \, dm^3$ — 5

$\frac{}{40}$

c) I copper (II) chloride

II dinitrogen tetraoxide

III hydrobromic acid

IV perchloric acid

$4 \times 05 = 20$ $\frac{}{20}$

7. a) I Pt wire / pencil is dipped in conc. HCl and heated to obtain colourless flame. Then again it is dipped in conc. HCl and the given salt and heated in flame. One that gives yellow flame is NaCl and the other one is KCl. — 10

II Aqueous solutions of equal concentration of the nitrates of group 2 elements prepared and equal volumes of each solution taken in test tubes separately. Aqueous solution of Na_2CO_3 of a particular concentration is made and added to the solution taken in the test tube dropwise until a precipitate appears. The number of drops added are recorded. It could be seen that number of drops decreases along the group. Hence solubility decreases along group the group from top to bottom — 10

vii CO - neutral CO_2 - weak acid.
NO / N_2O_2 - neutral.
N_2O - neutral.
NO_2 / N_2O_4 - acidic
N_2O_5 - Strong acid.
SO_2 - weak acid.
SO_3 - strong acid.
P_2O_3 / P_4O_6 - weak acid
P_2O_5 / P_4O_{10} weak acid —— 10

30

b) I Cr —— 10 II $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ —— 5

III CrO weak base Cr_2O_3 - amphoteric
CrO_2 weak acid CrO_3 - acid —— 10

IV purple → greenish precipitate → dark greenish solution
$[Cr(H_2O)_6]^{3+}$ $Cr(OH)_3$ $NaCrO_2$ / $NaCr(OH)_4$
$6 \times 3 =$ 18

V yellow coloured solution obtained —— 5
$2Cr(OH)_{3(s)} + 3H_2O_2 + 4OH^- \longrightarrow 2CrO_4^{2-} + 8H_2O$ —— 10

VI Orange coloured solution —— 5
$2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$. —— 10

VII alloy —— 7

80

c) I $\Delta H = -\frac{484}{2} kJ = -242 kJ mol^{-1}$ —— 10

II $\Delta S = S_{products} - S_{reactants}$.
$= 190 J mol^{-1} K^{-1} - (130 J mol^{-1} K^{-1} + \frac{205}{2} J mol^{-1} K^{-1})$
$= -42.5 J mol^{-1} K^{-1}$ —— 10

III $\Delta G = \Delta H - T\Delta S$
$= -242 kJ mol^{-1} - 373 K \times (-42.5 \times 10^{-3}) J mol^{-1} K^{-1}$
$= -242 kJ mol^{-1} + 15.853 kJ mol^{-1}$
$= -226.147 kJ mol^{-1}$ —— 10

40

IV yes. $\Delta G < 0$. —— 10