



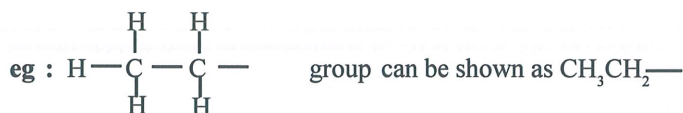
G.C.E. (A/L) Student Support Seminar - 2013
Revision Paper
Chemistry II
Launched under the Supervision of Ministry of Education
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* Universal gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

* Avagadro's Constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Time 3 Hours

* You are allowed to show the alkyl groups in the contracted form



Part - A Structured essays

* Answer all questions in this paper.

* Provide answers for each question in the space given . This space is sufficient for the answer and we do not expect long answers

Part B & Part C - Essay

* Select two questions from each part and answer four questions all together.

* Attach part A, Part B, and part C together, keeping Paper A on top of the answer script and hand over the completed answer script to the supervisor.

* You are permitted to take Part - B of the question paper out of the examination centre.

For Examiners' use only.

Part	Question No	Marks
A	1	
	2	
	3	
	4	
	5	
B	6	
	7	
	8	
C	9	
	10	
Total		
Percentage		

Final Mark

In Figures	
In Letters	

Code Numbers

Examiner	
Checked by 1.	
2.	
Supervision	

Part A - Structured Essay type

Answer all four questions on this paper itself (marks allocated for each question is 10)

1. (a) i) Write the electron configuration of element X which has the atomic number 24 in the normal way like $1s^2, 2s^2, \dots$

ii) Mention the four common oxidation states of the element X

.....

iii) Write the chemical formula of the oxide which is derived from the highest oxidation state of X

.....

iv) If the oxide mentioned in (iii) reacts with conc. HBr to give write down the balanced chemical equation for the relevant reaction.

.....

- (b) Answer the following parts (i) to (v) based on the structure of hydrocyanic acid given below



(i) Draw the most acceptable Lewis structure of this compound

.....

(ii) Draw the resonance structures for the above compound and give reasons for their relative stability.

.....

.....

.....

.....

(iii) Deduce the shape around each atom given below of the structure you mentioned in (b)(i) using VSEPR theory

i) Around O ,

.....

.....

.....

2) Around C

.....

.....

.....

(iv) Identify the orbitals that participate in forming of bonds C-N and O-H hydrocyanic acid.

(1) C

(2) O

(v) Identify the orbitals that participate in forming of bonds C-N and O-H hydrocyanic acid..

Bond	orbitals
1) O — H	
2) C — N	

(c) Identify the primary interactions and secondary interaction in each substances given in the table below and write them appropriate in the spaces given.

	substance	Primary Interaction (As Ionic/polar covalent/Non-Polar Covalent)	Secondary Interaciton (As Bipolar-Bipalar/Hydrogen bonds/ London forces)
(i)	Ice (Solid)		
(ii)	Silicondioxide(solid)		
(iii)	Hydrogen fluoride		
(iv)	Magnesium Sulphide (solid)		
(v)	Chlorine (gas)		
(vi)	Mercury (Liquid)		

2 (a) (i) Write the formulae for the hydrides of the elements Sodium to chlorine in the third period the periodic table. And mention their acidic or basic mature separately. Formula Acidic-basic nature

Formula	Acidic-basic nature
.....
.....
.....
.....
.....
.....
.....

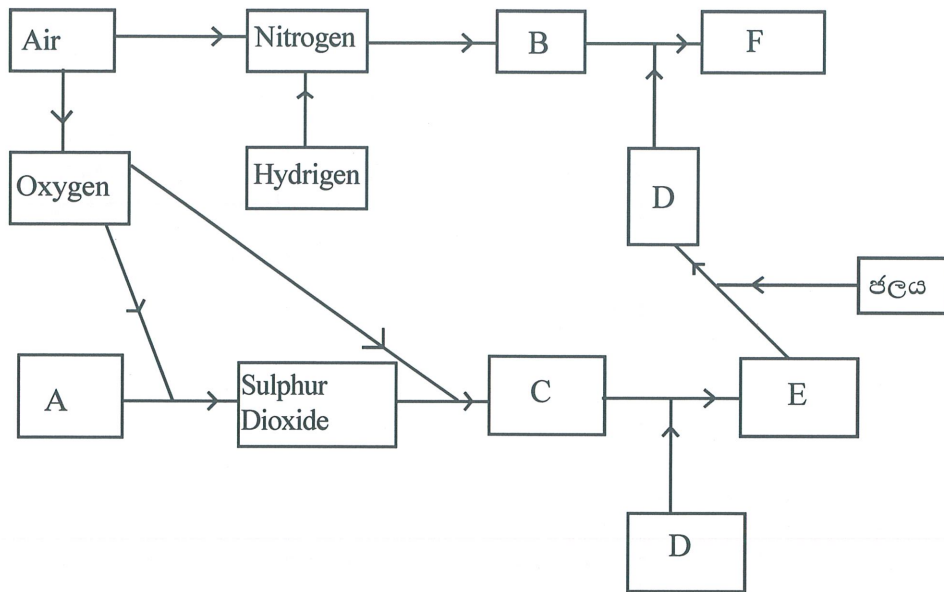
(ii) Mention the hydride/s out of those mentioned in (I), that react with water and liberate hydrogen

.....

(iii) What is the hydride that combusts spontaneously when exposed to air?

.....

(b) Given below is a flow chart that shows two important industrial processes. Answer the following questions using it.



(i) Give the formulae of the substances denoted by A,B,C,D,E, and F

A..... B.....
 C..... D.....
 E..... F.....

(ii) Mention another use of $N_2(g)$ and $O_2(g)$.

.....

(iii) $N_2(g)$ සහ $O_2(g)$ හි වෙනත් ප්‍රයෝජනයක් බැගින් සඳහන් කරන්න.

$N_2(g)$
 $O_2(g)$

(iv) Name another important product obtained by the process in (ii) and mention one of its uses.

.....

(v) State desparately the catalysts used in the two industrial processes shown in the above flow chart

Industrial Process	Catalysts

(c) Iodine and chlorine react with each other to give a compound named ICl_n when $1 \times 10^{-3} \text{ mol}$ of ICl_n was reacted with excess amount of KI , all the iodine in that compound was converted to I_2 of 0.1 mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3$ solution was used to react completely with that I_2

(i) Calculated the value of n.

.....
.....
.....
.....

(ii) Write the balanced chemical equation for the reaction between Cl_2 and I_2

.....

3. a) (i). I Deduce Charlis law using the equation $PV = nRT$.

.....
.....
.....
.....

(ii) A mass of 12.0 g of an inert gas was in a vessel of volume $V \text{ dm}^3$ cooperative $t \text{ }^\circ\text{C}$.The pressure of that gas was $1.0 \times 10^5 \text{ Nm}^{-2}$. The pressure of the gas increased by 10% when the temperature was increased by $10 \text{ }^\circ\text{C}$

(IE. Molar mass of the inert gas is 120 g mol^{-1})

I) Calculate the initial temperature t of the gas

.....
.....
.....
.....

II) Calculate the volume, V of the vessel

.....
.....
.....
.....

III) write down the assumptions you make for the above calculation.

.....
.....
.....
.....

b) It is found that 4.00 g of an organic compound, X is in 50.0 cm³ of aqueous solution. To extract the organic compound in to ether, the solution was well stirred with 100.0 cm³ of ether and allowed to reach equilibrium. Then it is observed that 0.80 g of X is left behind in aqueous phase.
 (Molar mass of X is වල මවුලික ස්කන්ධය 125 g mol⁻¹)

(I) What is the mass of X, extracted in to ether?

.....

(II) Calculate the coefficient of distribution of X, between ether and water at the relevant temperature.

.....

(III) If the extraction was done by using 4 samples of 25 cm³ of ether each, instead of 100 cm³ of ether what is the mass of X extracted in to ether?

.....

C) Answer the following questions using the data given for the reaction



ප්‍රතික්‍රියාව හා සම්බන්ධව දී ඇති දත්ත ඇසුරින් අසා ඇති ප්‍රශ්න වලට පිළිතුරු සපයන්න.

$G_f \text{ CO}_2\text{(g)}$	-394.4 kJ mol ⁻¹
$G_f \text{ CO(g)}$	-137.2 kJ mol ⁻¹
ΔS^\ominus for the reaction	-0.188 kJ mol ⁻¹ K ⁻¹

I) Show that the above reaction is exothermic at 300 K

.....

II) Deduce whether above reaction occurs spontaneously at 300 K

.....

III) Mention the assumptions you made for the above calculations.

.....

4) a.) P, Q and R are the three halogenated hydrocarbons with the common molecular formula of $C_5H_{10}Br_2$ but have three different structural formulae. When they are treated separately with aqueous KOH in alcoholic media, it gives same chemical compound S as the main product. Compound Q shows optical (enantiomeric) isomerism, and compound R reacts with aqueous KOH to give a symmetrical ketone as the product. Identify the compounds P, Q and R separately and write their structure in the boxes below

I) Identify the compounds P, Q and R separately and write their structure in the boxes below .

P

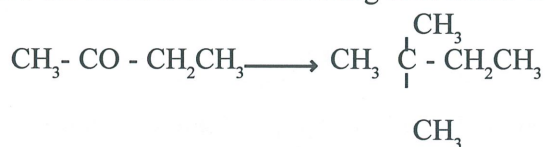
Q

R

II) The above compound was subjected to fractional hydrogenation in the presence of S Pt/Cd catalyst. When the product T thus obtained is brominated, you can get the compound Q again. Write a suitable mechanism for the conversion of T \rightarrow Q

.....

b) i) Show the method for the following conversion in not more than 6 steps.



Use another compound, which is not a carbonyl compound and have Sp^2 hybridized carbon atoms.

.....

ii) Draw the Structure of the main products that 2-butanone gives in the presence of a dilute alkali

.....

iii) Comment on the isomerism of the structures mentioned in (ii)

.....



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Revision Paper - Chemistry II

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Time 2 hours

* Universal gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

* Avogadro constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Part B --- Essay type

Answer **Two** questions only (15 marks for each question)

(05) (a) (I) I clarify the following terms using suitable balanced equations.

- (i) Standard Enthalpy of atomization of bromine
- (ii) Standard Enthalpy of bond dissociation of bromine
- (iii) Enthalpy of neutralization of acetic acid

(II) State and experiment that can be done in the laboratory to find the enthalpy of neutralization of acetic acid show how the calculation is done mentioning the assumptions made

(III) The stable allotropic form of phosphorous P_4 (white phosphorous) burns in excess oxygen and gives a white powder with formula P_4O_{10} . Calculate the enthalpy of sublimation of in symbolic form P_4O_{10} . Thermodynamic data mentioned mentioning the assumptions made

$$\text{Enthalpy of formation of } P_{(g)} \quad \Delta H_f P_{(g)} = y \text{ kJ mol}^{-1}$$

$$\text{Enthalpy of formation of } O_{(g)} \quad \Delta H_f O_{(g)} = x \text{ kJ mol}^{-1}$$

$$\text{Enthalpy of combustion of } P_{4(s)} \quad \Delta H_c P_{4(s)} = z \text{ kJ mol}^{-1}$$

$$\text{Enthalpy for the conversion of } 142.0 \text{ g of } P_4O_{10(s)} \text{ to gaseous atoms} = a \text{ kJ mol}^{-1}$$

$$(P = 31; O = 16)$$

(b) A certain mass of solid NH_4Cl was kept in a vessel the volume of which was 0.5 dm^3 , at the temperature of 400 K and allowed to attain to the equilibrium at that temperature. The barometer reading of that system in equilibrium was $8314 \times 10^5 \text{ N m}^{-2}$.

- (i) If the partial pressure of the gas ammonia at 400 K is 0.5 atm . What should be the partial pressure of the gas HCl ? ($1 \text{ atm} = 1 \times 10^5 \text{ N m}^{-2}$)
- (ii) What should be the K_c of the system at that temperature?
- (iii) Another 10 mol of NH_4Cl was added to the system, maintaining the same temperature and allowed to attain to the equilibrium. Calculate the mass of HCl in the system in equilibrium.

$$(H = 1; N = 14; Cl = 35.5)$$

- (iv) If 2.0 moles of He gas was added to the system in equilibrium in part (III), how will it affect to the partial pressure of HCL in the system? Explain this qualitatively.
- (v) Suggest a suitable experiment to find the equilibrium constant K_p of the system in equilibrium formed by dissociating the above $\text{NH}_4\text{Cl}_{(s)}$ at 500 K
(Experimental details are not necessary)

- (06) (a) (I) What do you mean by the form buffer solution?
(II) A buffer solution containing the salt BCL results when excess amount of the base BOH in reacted with HCL. Show that the , pOH value of this solution.

$$\text{pOH} = \text{p}K_b + \log \frac{[\text{BCL}_{(aq)}]}{[\text{BOH}_{(aq)}]}$$

- (III) A volume of 400cm^3 of the weak base BOH was reacted with a solution of HCL in the concentration of 0.1 mol dm^{-3} . volumes of HCL added and pH values of the solution in each instance is given below.

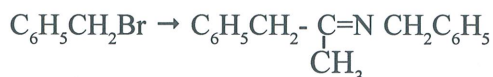
	Value of HCl Valuve	pH of the solution
1.	5.00 cm^3	10.04
2.	20.00 cm^3	9.14

A valuve of $V\text{cm}^3$ HCL, was necessary to neutrolize the base competely.

- (i) Give two expressions for the concentrations of the ase, left behind in the solution without reacting, in the instances that pH is 10.04 and 9.14
(ii) what is the voluve of above $V\text{ cm}^3$?
(iii) calculate the dissociation constan ((K_b)of the base at the relevent temperature.
(iv) calculate the dissociation constan (k_b) of the base at the relevent temperature (i.e; Consider that ionic product of water is $1 \times 10^{-14}\text{ mol}^2\text{dm}^{-6}$ at relevent temperature.)
- (b) (i) $\text{Hg}_2\text{I}_{2(s)}$ is a solid ionic compound which is slightly soluble in water. Deduce and expression for the Kspof this compound using relevant principles.
(ii) There are calions $\text{Ag}^+(\text{aq})$ and $\text{Hg}_2^{2+}(\text{aq})$ in and aqueous solution. Concentrations of each of there are 0.1 mol dm^{-3} in relation to each other. Show that which cation precipitates first as as iodide, when a solution of NaI is added gradually in to the above solution
- (K_{sp} of $\text{AgI}_{(s)} = 8.5 \times 10^{-17}\text{ mol}^2\text{dm}^{-6}$
 $\text{Hg}_2\text{I}_{2(s)}$ of K_{sp} of $= 2.5 \times 10^{-26}\text{ mol}^3\text{dm}^{-9}$ at the relevent temperature)
- (iii) At the Moment that second cation starts to precipitale.
(a)What is the percentage cation concentration left behind, which stared to precipate frist?
(b)What is the precipitated cation concentration which started to precipitate frist?

(7) (a) Give reasons for the followings

- (i) A pure sample of CCl_4 can not be prepared by the reaction of methane gas with chlorine gas in the presence of difused sunlight.
- (ii) Acidic properties are higher in nitrophenols than in phenol.
- (b) (i) State how the following conversion is done minimum number of steps using CH_3MgBr as the only organic compound, and using the given inorganic reagents appropriately.



[inorganic reagents : H_2O , dil. H_2SO_4 , $\text{NH}_3(l)$, $\text{CaC}_2(s)$,
 $\text{HgSO}_4(aq)$, LiAlH_4 , KMnO_4]

(c) How do you differentiate the following pairs of compounds using minimum number of chemical tests?

- (i) $\text{C}_6\text{H}_5\text{CONHC}_6\text{H}_5$ සහ $\text{C}_6\text{H}_5\text{CONHCH}_2\text{C}_6\text{H}_5$
(ii) $\text{CH}_3\text{CH}_2\text{Cl}$ සහ $(\text{CH}_3)_3\text{CCl}$
(iii) HCOOCH_3 සහ $\text{CH}_3\text{COOCH}_3$

Part C- Essay Type

Answer Two Questions only (15 Marks for each question)

(8) (a) There is only one unpaired electron in M, which is a 3d element in the periodic table. M does not react with dil. HCl, but reacts with dil. HNO_3 and gives a colorless gas G and a coloured solution L

i. Identify M, giving reasons

ii. Mention two industrial uses of M.

iii. State a chemical test, to identify the gas G.

iv. Write the balanced chemical equation for the reaction of M with dil- HNO_3

v. When excess conc. HCl is added to solution L, the result is a coloured solution Q. And when excess conc. NH_3 is added to solution L, the result is a coloured solution R. Mention the colours of L, Q and R; the shapes of those coloured species and their IUPAC name separately.

(b) X, Y, Z and aqueous solutions of the salts of three elements that belong to the d-block. Aqueous NaOH solution was added to each solution above Separately

X: A white precipitation was obtained. It dissolved in excess aqueous NaOH solution, as well as in excess aqueous NH_3 solution

Y: A green precipitation was obtained. It did not dissolve in excess NaOH solution, but dissolved in excess aqueous NH_3 solution.

Z: A yellowish brown precipitation was obtained. It did not dissolve in excess NaOH solution or in excess NH_3 solution.

i. Identify X, Y, and Z using the above observations.

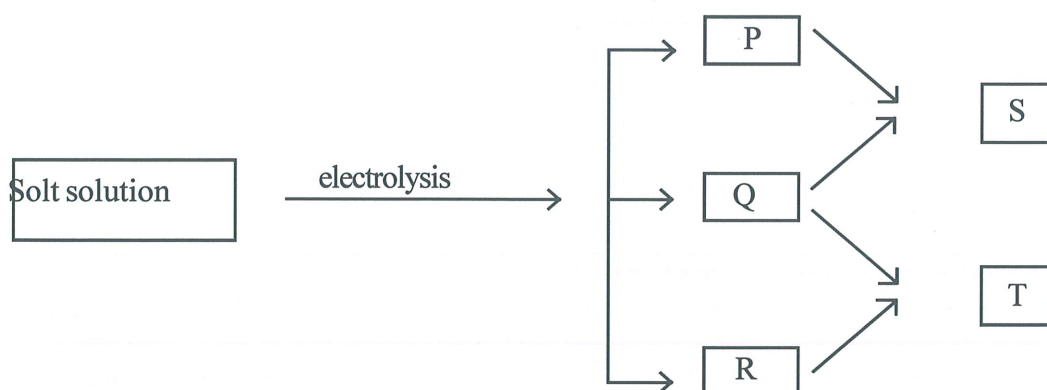
ii. If you are supplied with a solid mixture of the elements X, Y, and Z in part (i) how do you determine the percentage, by weight, of those elements?

(c) 2.39g of a solid mixture, which contains only ammonium chloride and ammonium sulphate, was dissolved in water and the solution was prepared to a volume of 250.0 cm³. 25.0 cm³ of that solution was taken in to a beaker and 50.0 cm³ of 0.2 mol dm⁻³ NaOH solution was added. This mixture was boiled to remove all the ammonia and was titrated with 0.3 mol dm⁻³ HCl solution. Volume of HCl used was 20.0 cm³.

(N=14; H = 1 ; S=32 ; Cl = 35.5; O = 16)

- i Write the balanced chemical reactions occurred here
- ii Calculate the mole percentage of NH₄Cl in the mixture.

(9) a Substance P, Q and R, obtained by electrolysis of a solution of NaCl (common salt) are used as raw materials for many industrial processes.



(Here P, Q, R, S and T are not accepted symbols)

- i Write the formulae of the substances P, Q, R, S, and T
- ii Mention one use each of P, Q, R, S, and T
- iii Clarify the physio-chemical principles applied in the above electrolytic process in industry.
- iv What are the adverse effects to the environment in this industrial process? (only four points will be sufficient)

b A solution the volume of which is 1000 cm³ was prepared by dissolving sodium oxalate and anhydrous oxalic acid in water. 25.0 cm³ of this solution was titrated with 0.1 mol dm⁻³ NaOH using phenolphthalein as indicator. Volume of NaOH solution used here was 17.6 cm³. 40 cm³ of 0.2 mol dm⁻³ KMnO₄ solution was used to neutralise another 25.0 cm³ of the inertial solution under acidic condition. Calculate separately the concentrations of sodium oxalate and oxalic acid in the solution.

c Disprin the common pain killer contains acetylsalicylic acid mixed with CaCO₃ and starch.

(i) What is the common name for acetylsalicylic acid?

- (ii) what is the chemical reaction that you expect, when a tablet of disprin is put in to water?
- (iii) How do you show, in the laboratory, that a tablet of disprin contains the three constituents mentioned?
- (iv) Mention briefly a test to determine the amount of CaCO_3 quantitatively, in a tablet of disprin.

10 (a) I. Consider the following reaction



This is a second order reaction with respect to $[\text{NO}]$ and is a first order reaction with respect to $[\text{Br}_2]$.
Activation energy of the above reaction is $+5.4 \text{ kJ mol}^{-1}$.

- i Write the rate equation and mentioned the units of rate constant for the above reaction, depicting all the energy changers
- ii Draw a tablet energy diagram to show the pathway of the above reaction depicting all the energy changers.

II $\text{NO}(\text{g})$ gas reacts with $\text{O}_2(\text{g})$ to give $\text{NO}_2(\text{g})$ according to the following equation.



results of an experiment done to determine the order of above reaction is given below.

Experiment	Initial concentration (mol dm^{-3})		Initial rate of formation ($\text{mol dm}^{-3} \text{ s}^{-1}$)
	$[\text{NO}]$	O_2	
1	1×10^{-3}	1×10^{-3}	7×10^{-6}
2	1×10^{-3}	2×10^{-3}	14×10^{-6}
3	1×10^{-3}	3×10^{-3}	21×10^{-6}
4	2×10^{-3}	3×10^{-3}	84×10^{-6}
5	3×10^{-3}	3×10^{-3}	189×10^{-6}

- i) Determine the rate in relation to NO and O_2
 - ii) Write the rate equation that shows the steps of determining the above speed.
 - iii) It is seen that the steps determining the speed have is abnormal. what could be the reason for that?
- (b) i) Graphite layer is applied on plastic items before they electroplated with silver. clarify the reason for this
- ii) what is the other electrode used in the electrolytic cell, in the above electro plating?
 - iii) Draw a labeled diagram of the electrical circuit with the electrolytic cell used for the above electroplating
 - iv) How long should b an electrical current of 0.1 A be flown through the electrolytic cell to deposit 1.089g of silver in the plastic item?
($\text{Ag} = 108$) Faraday constant 96500 C mol^{-1})
 - v) Is it suitable to apply copper initially on the plastic item, instead of graphite, in this electroplating? Give your ideas.

(c) Chlorine is used in water purification .

i) Write the balanced equation for the reaction of chlorine with water.

ii) Clarify how bacteria are destroyed by this solution

iii) P^h value of the above solution should be controlled carefully to maintain the activity of Cl₂ in it.

Clarify the reason for this using the equation in (c) I.

iv) Mentioned two other methods other than chlorination ,to purify water
