



Provincial Department of Education

Northern Province

Pilot Exam - October 2021



இரசாயனவியல் - II
Chemistry - II

02

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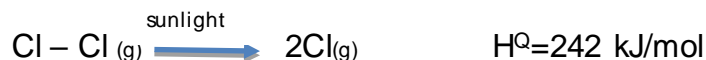
II

PART-B Essay

Answer two questions only

5.

(a) In the presence of sunlight H_2 gas reacted with Cl_2 gas in explosively.



i. In the above reaction, calculate the wavelength for the absorbed energy when Cl_2 gas broken.

$$(h = 6.6 \times 10^{-34} \text{ JS}, C = 3 \times 10^8 \text{ ms}^{-1} L = 6.02 \times 10^{23} \text{ mol}^{-1})$$

ii. Standard bond dissociation energies for $\text{H}_{2(g)}$, $\text{Cl}_{2(g)}$, and $\text{HCl}_{(g)}$, are 432, 242, 431 kJ/mol respectively. Find the standard enthalpy of formation of HCl gas.

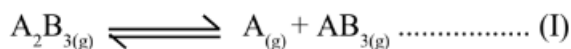
Substance		H_2	Cl_2	HCl
Entropy	$\text{J mol}^{-1} \text{ K}^{-1}$	131	121	187

iii. Using the above given data, find standard entropy change (ΔS^0) for the formation of $\text{HCl}_{(g)}$

iv. Calculate the Gibbs energy Change (ΔG^0) for the reaction, then deduce the spontaneity of the reaction with reason.

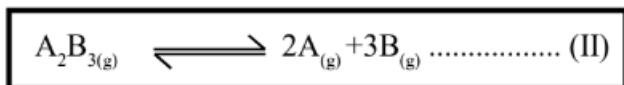
v. Give the reason briefly, why the above reaction takes place with explosion.

(b)



A sample of $X \text{ mol A}_2\text{B}_{3(g)}$ was placed in an evacuated rigid container. At $T \text{ K}$ temperature 40% of $\text{A}_2\text{B}_{3(g)}$ dissociated in the initial amount and reaches the above equilibrium (I). The total pressure of the system was found to be $7 \times 10^5 \text{ Pa}$. Calculate the equilibrium constant K_p for the above reaction at $T \text{ K}$.

- (c) When the temperature was raised to 2 TK $A_2B_{3(g)}$ reaches the equilibrium (II) as given below.



When the temperature was raised to 2T K ,20% of $A_2B_{3(g)}$ dissociated in the initial amount (x mol) and 20% of $A_2B_{3(g)}$ was remained.

- i. Calculate the moles of each gases regarding with X at 2T K .
- ii. Find the total pressure of the container at 2T K.
- iii. Let the equilibrium constant for equilibrium (I) is K_{p1} and for equilibrium (II) is K_{p2} respectively at 2T K.Find the expression for the ratio K_{p1} / K_{p2} .
- iv. Find the value of K_{p1} and K_{p2} at 2T K.
- v. Give any assumptions in the above calculations.

Q6 (a)

- i. Define the term Solubility Product.
- ii. CaC_2O_4 is a sparingly soluble strong electrolyte.Give two methods to increase its solubility in water.
- iii. The solubility of $Mg(OH)_2$, is $2 \times 10^{-4} \text{ mol/dm}^3$ at 25°C .Calculate its solubility product at 25°C .
- iv NH_4OH is added to a solution of $0.001 \text{ mol/dm}^3 \text{ MgCl}_2$.
Calculate the minimum concentration of NH_4OH required to form $Mg(OH)_2$ precipitate. ($k_b(NH_3) = 1.6 \times 10^{-5} \text{ mol/dm}^3$)
- v. In qualitative analysis ,some cations can be precipitated as sulphides in acidic medium , and some are not precipitated .A solution contains $0.10 \text{ mol/dm}^3 \text{ Co}^{2+}$ and $0.01 \text{ mol/dm}^3 \text{ Fe}^{2+}$ ions.What should be the pH range of the solution if they are separated in acidic medium by H_2S passing through the solution.Given that

In a solution $H_2S_{(aq)}$ has a concentration of 0.1 mol dm^{-3}

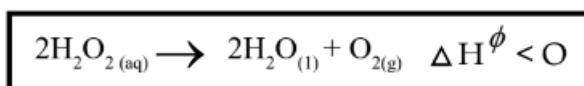
K_{a1} of H_2S $9.1 \times 10^{-8} \text{ mol/dm}^3$

K_{a2} of H_2S $1 \times 10^{-19} \text{ mol/dm}^3$

$K_{sp}(CoS) = 4 \times 10^{-21} \text{ mol}^2/\text{dm}^6$

$K_{sp}(FeS) = 6.3 \times 10^{-18} \text{ mol}^2/\text{dm}^6$

- (b)Decomposition of $H_2O_{2(aq)}$, is activated in the presence of $Br_{2(aq)}$



- i. Identify the catalytic type and explain briefly
- ii. Write the rates of the reaction with respect to the consumption of $H_2O_{2(aq)}$ and the formation of $H_2O_{(l)}$, $O_{2(g)}$
- iii. In an experiment the rate of formation of $H_2O_{(l)}$ was found to be $7.4 \times 10^{-2} \text{ mol dm}^3 \text{ s}^{-1}$.
find the rate of the consumption of $H_2O_{2(aq)}$
- iv. Derive an expression for rate R related with rate constant K and concentration of $H_2O_{2(aq)}$, $Br_{2(aq)}$ (Order of $H_2O_{2(aq)}$, $Br_{2(aq)}$ are x and y respectively.)

- v. In an experiment details given at a particular temperature .Calculate the orders x and y.

Experiment No	$[H_2O_{2(aq)}]$ Mol dm ⁻³	$[Br_{2(aq)}]$ Mol dm ⁻³	Initial rate Mol dm ⁻³ S ⁻¹
1	0.10	0.10	8.0×10^{-4}
2	0.20	0.10	1.6×10^{-3}
3	0.20	0.20	3.2×10^{-3}

- vi. Find the rate constant K for the above reaction.
 vii. Using your calculations deduce that the above reaction is a single step / multi step .Then give a suitable mechanism for this reaction.
 viii. Using your mechanism given above (vii) , draw the Energy profile diagram.

Q7) a) In SriLanka some agricultural areas like Jaffna and Nuwara Eliya, most of the chemicals used in agriculture. One of the chemical X mostly pollute water. The chemical X soluble in ether.

100cm³ of above water sample was taken and added 300 cm³ of ether in three times. Each time 100cm³ of ether was added to 100 cm³ of water sample (same water sample).

In first attempt 100 cm³ of ether was added and allowed to reach equilibrium . 20% of mass of initial amount remained in aqueous layer.

After the third attempt ,concentration of remaining X in aqueous layer was 10ppm (Relative molecular mass of X is 180)

- Calculate the partition coefficient of X between ether and water ?
- Find the initial concentration of X in aqueous layer? (In mol/dm³)

(b) An ideal binary liquid mixture was prepared by mixing two liquids A, and B in a closed evacuated container at temperature T.

Mole fraction of A and B in solution X_A, X_B

Mole fraction of A and B in vapour phase Y_A, Y_B

Saturated vapour pressure of A and B P_A^0, P_B^0

- Show that mole fraction of A in vapour phase

$$Y_A = \frac{X_A \cdot P_A^0}{X_A \cdot P_A^0 + X_B \cdot P_B^0}$$

ii. When $X_A = 0.7$ $Y_A = 0.5$, $P_A^\circ = 1 \times 10^4 \text{ Nm}^{-2}$ $P_B^\circ = 3 \times 10^4 \text{ Nm}^{-2}$. Find the total pressure and Y_A .

iii. Draw the suitable vapour pressure Vs mole fraction graph for liquids A,B. Mark the portions in this graph.

iv. Give a method to separate the liquids A and B.

(C) The following substances given you to construct an electrochemical cell

1.0 mol / dm³ ZnSO₄ solution, 1.0 mol / dm³ MSO₄ solution
Zn, M electrodes, Conducting wires, Porous plate, Voltmeter

Zn²⁺/Zn electrode potential = - 0.76 V

M²⁺/M, electrode potential = + 0.34 V

i. Draw the standard electrochemical cell diagram and indicate its portions.

ii. Indicate anode, cathode and write down the half cell reactions.

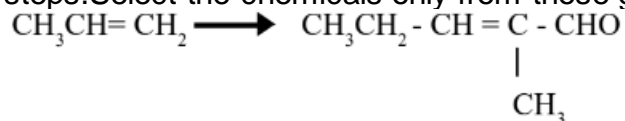
iii. Calculate the cell potential

iv. Explain how to change emf when adding water to Zn²⁺ solution.

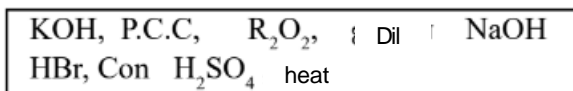
v. State the direction of migration of ions through the porous plate.

PART II C (ESSAY)
Answer two questions only

08) a) Show how the following conversion could be carried out in not more than six steps. Select the chemicals only from those given in the list.

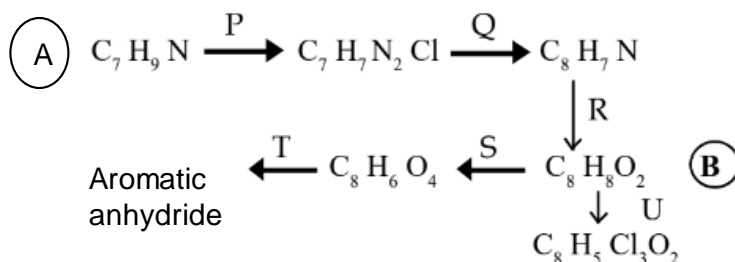


List of chemicals



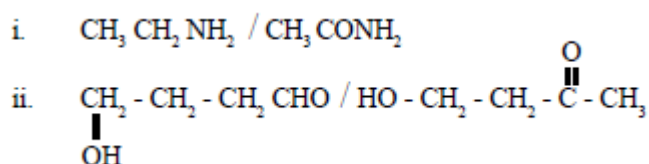
A is a primary aromatic amine. The reaction scheme given below.

B reacts with Na_2CO_3 and gives CO_2 gas.



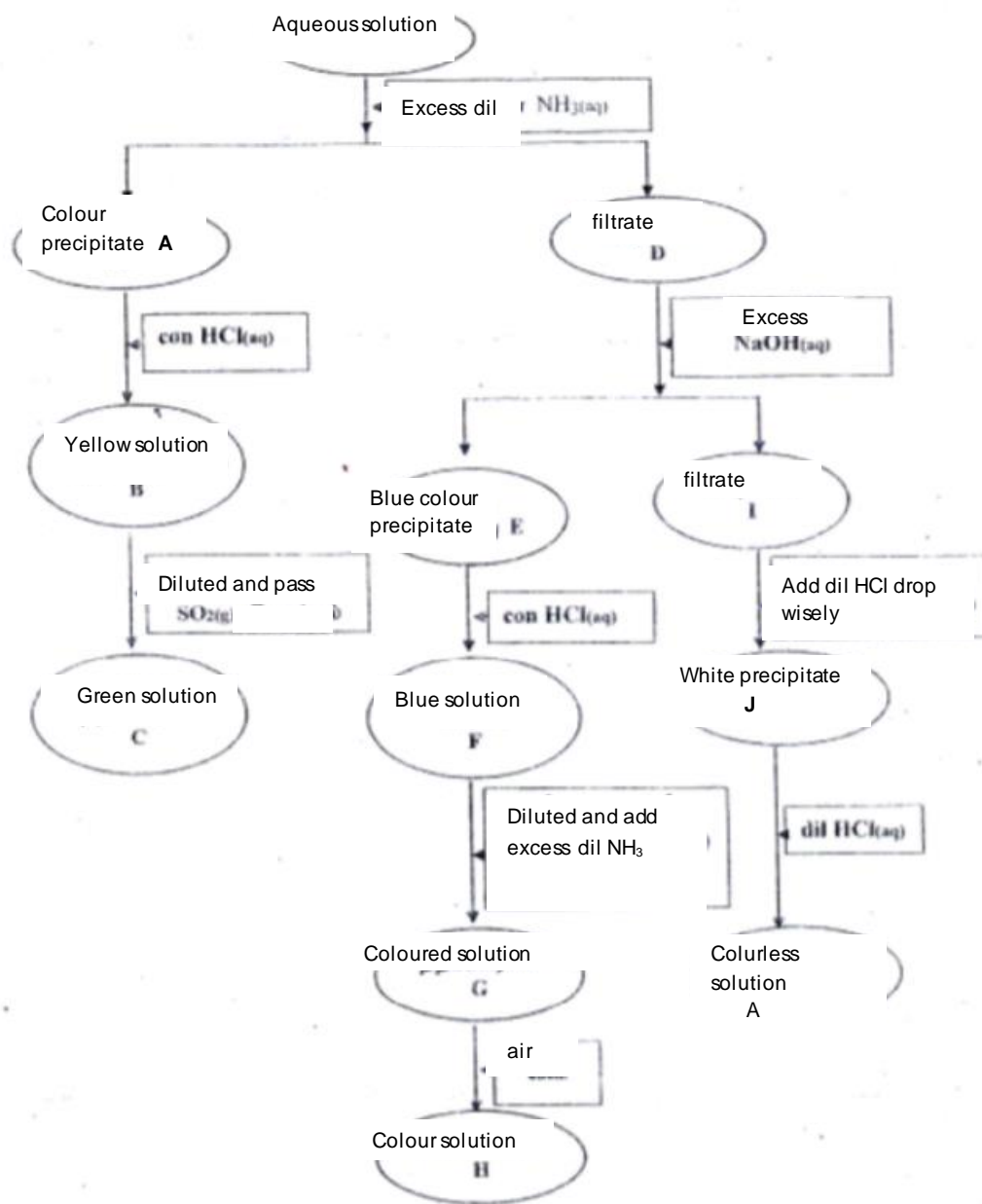
Identify the reagents P, Q, R, S, T, U with conditions.

c) Give one experiment to distinguish the two compounds.



d) Bromine water reacts with phenol and gives 2,4,6 –tribromophenol - a white precipitate immediately. But benzene does not react with bromine water. Explain briefly.

9. The aqueous solution contains only nitrates of three cations. Their experimental details and observations are given in the flow chart below.



i. Identify A,B,C,D,E,F,G,H,I,J and K

ii. Give balanced chemical equations for the changes $B \xrightarrow{\quad} C$ and

$I \longrightarrow J$

iii. Identify the cations in the aqueous solution

iv. Give the colour of the solutions G and H.

B) A group of students try to determine the concentration of $\text{Na}_2\text{S}_2\text{O}_3$. 2.14g of KIO_3 was taken accurately and added excess KI , H_2SO_4 and made upto 250 cm^3 solution. 25.0 cm^3 of the solution was taken and titrated with $\text{Na}_2\text{S}_2\text{O}_3$ solution. The required volume of $\text{Na}_2\text{S}_2\text{O}_3$ was 60.0 cm^3 .

i. Write all the balanced chemical equations.

ii. Calculate the accurate concentration of $\text{Na}_2\text{S}_2\text{O}_3$.

(K = 39, I = 127, O = 16)

c) 1.00g of anhydrous CuSO_4 sample contains some water soluble inert impurities. The sample was dissolved in water and made upto 250 cm^3 solution. 25.0 cm^3 of this solution was taken and excess $\text{KI}_{(\text{aq})}$ was added. The liberated I_2 was titrated with above standard $\text{Na}_2\text{S}_2\text{O}_3$ with suitable indicator. The burette readings were $8.00, 8.10, 8.10 \text{ cm}^3$ (Cu=64, O=16, S=32)

i. Give the suitable indicator for this titration

ii. When this indicator was added, give the reason

iii. Write balanced chemical equations for all chemical changes mentioned above.

iv. Calculate mass percentage of CuSO_4 in the sample.

10 (a) The following questions are based on the extraction of iron. The manufacture carried out by the heat reduction method

- (i) Name the raw materials in the process (except coke).
- (ii) Why heat reduction method is used?
- (iii) Give two facts to attention in the process of iron production.
- (iv) Give three role of coke in this process and write suitable equations
- (v) Indicate the temperature range in blast furnace.
- (vi) Give any three reactions takes place in lower part of the blast furnace.
- (vii) What is meant as "slug" in this process? Give two components of it and write the usage of it in iron extraction.
- (viii) The liberating carbon dioxide reacted with coke at high temperature and produce $\text{CO}_{(g)}$. This process is spontaneous. Explain why it is spontaneous.

(b). Air pollution caused by industrial emissions. Human activities, natural processes and the activities of animals also increase the air pollution.

- (i) Give four main problems caused by air pollution
- (ii) Give two gases for each problems in the above mentioned (i)
- (iii) Related the air pollution
 - (I) Industrial emissions
 - (II) Human activities
 - (III) Natural process
 - (IV) Activities of Animal

Give two ways to each of the above contribute to air pollution.

(iv) In the above one of the process, in the presence of sunlight gives PAN and another gaseous product. This gaseous product protect us but sometimes it is harmful. Identify the gas and explain how (i) it is advantage

(ii) it is disadvantage

(v) Does the amount of atmospheric carbon dioxide increases, pH of water decreases. Justify your answer using equations.

(c). The following questions are based on Biodiesel production

- (i). State the raw materials used in the manufacture of Biodiesel.
- (ii). Give the five steps involve in the production of Biodiesel
- (iii) Give the balanced chemical equations to the synthesis of biodiesel
- (iv) How to differ the above (iii) reaction from soap production
- (v) Natural fertilizer is more suitable than artificial fertilizer. Give the disadvantages of artificial fertilizer, using your knowledge of Chemistry.