

[4]

- c) Write a short note on partition chromatography.
- d) Among the frontal analysis, displacement and elution methods – which one is most useful method and why? Explain briefly. 3+2+2+3

Ex/DSE/Chem/TH/01/A/6011-I/2023

B. SC. CHEMISTRY EXAMINATION, 2023

(6th Semester)

CHEMISTRY (DSE)

PAPER: DSE/CHEM/TH/01

Time : Two Hours

Full Marks : 40

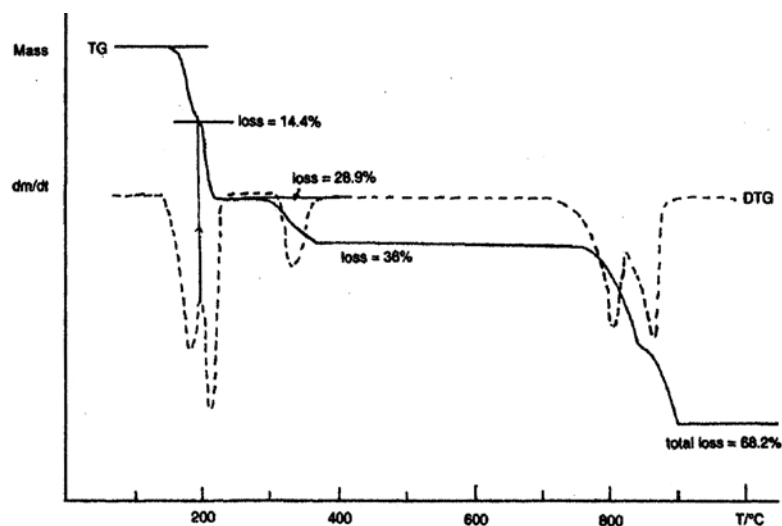
UNIT : 6011-I

Answer the following questions.

1. a) What is multistage extraction and why is it efficient than single stage extraction?
 - b) Acetyl acetone exists in tautomeric equilibrium and also forms stable complexes with different metal ions. This can be used to extract copper from its aqueous solution (at pH 2-5) to the extent 86.9%. Calculate how many successive numbers of extractions are necessary to remove 99.9% copper from a CuCl_2 solution (assuming volume ratio, $V_0/V = 1$).
 - c) What is the basic principle that governs continuous extraction in solvent extraction technique? How is continuous extraction different from continuous counter current extraction? Justify the nomenclature of continuous extraction and continuous countercurrent extraction. (1+1)+3+(1+2+2)
2. a) Explain the thermogram provided below that shows the decomposition of copper sulfate pentahydrate.

[Turn over

[2]



- b) Draw the schematic diagram of a thermobalance apparatus.
- c) Draw conductometric profiles: (a) when AgNO_3 is being titrated with KCl , (b) mixture of a weak acid and a strong acid by a weak base.
- d) Discuss the principle of "Potentiometric titration".
- e) Write the types of titration that fall under the category of potentiometric titration.
- 3+2+2+2+1
3. a) State and explain the Beer-Lambert law and write down the fundamental equation of colorimetry and spectrophotometry. State some instances where Beer-Lambert law is not applicable.

[3]

- b) The fundamental and first overtone transitions of $^{14}\text{N}^{16}\text{O}$ are centered at 1876.06 cm^{-1} and 3724.20 cm^{-1} , respectively. Evaluate the equilibrium vibration frequency, the anharmonicity constant and the force constant of the molecule.
- c) ν_{NO} stretching frequencies of $[\text{M}^{11}(\text{CN})_5\text{NO}]^{2-}$ ($\text{M} = \text{Fe}, \text{Ru}, \text{and Os}$) are $1938, 1927, \text{and } 1905\text{ cm}^{-1}$ respectively—Rationalize the trend with appropriate reasoning.
- d) Explain the different radiative and non-radiative processes in the light of Jablonski diagram when a molecule is excited by a photon.
- e) Calculate the excited state redox potentials for the following couples:
 (i) $[\text{Ru}(\text{bpy})_3]^{3+}/^*[\text{Ru}(\text{bpy})_3]^{2+}$ and (ii) $^*[\text{Ru}(\text{bpy})_3]^{2+}/[\text{Ru}(\text{bpy})_3]^+$
 [Given: $E_{1/2}([\text{Ru}(\text{bpy})_3]^{3+}/[\text{Ru}(\text{bpy})_3]^{2+}) = +1.26\text{ V}$; $E_{1/2}([\text{Ru}(\text{bpy})_3]^{2+}/[\text{Ru}(\text{bpy})_3]^{2+}) = -1.28\text{ V}$ and $E_{0-0} = 2.12\text{ eV}$. 2×5]
4. a) What are the factors that affect separation of solutes in column chromatography? Explain briefly.
- b) In a gas chromatography, if column length is 3 metres, and compounds elute in 5 min with $w_{1/2} = 5\text{ sec}$. What is the number of theoretical plates and what is the plate height?