

Indian Institute of Engineering Science and Technology, Shibpur

B.Tech 1st Semester End-Semester Examination, December 2023

Chemistry (CH1101)

Full Marks: 50

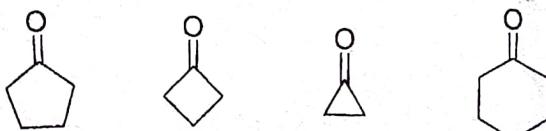
Time: 3 Hours

Answer all questions

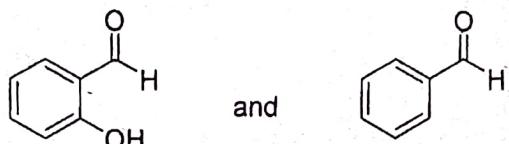
Use separate answer script for each half

1st Half (Unit-I)

1. (a) Arrange the following compounds in decreasing order of their C=O stretching frequencies of IR spectra and give appropriate explanation.



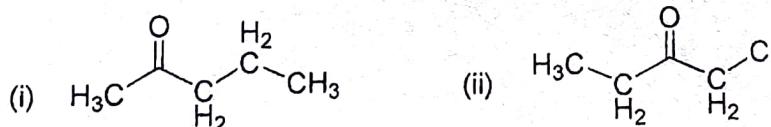
- (b) How can you distinguish following compounds by IR spectroscopy?



- (c) Name four commonly used NMR solvent. Write down intensity ratio of septuplet proton using Pascal's triangle.

- (d) Why tetramethylsilane (TMS) compound is taken as the standard reference in ¹H-NMR spectra? Calculate the Chemical Shift (δ) in ppm for a proton that has resonance 2208 Hz downfield from TMS on a spectrometer that operates at 400 MHz.

- (e) Draw and predict the number of signals and their relative intensities in the ¹H-NMR spectra of the following compounds.



- (f) Classify the polymers on the basis of *Tacticity*.

- (g) Write down the difference between the addition polymerization and condensation polymerization with proper examples.

- (h) In a polypropylene polymer, there are 200 molecules of molecular weight 10³, 300 molecules of molecular weight 10⁴ and 400 molecules of molecular weight 10⁵. Find out M_n , M_w and DP_n

[2+2+2+2+2+2+2+3]

1st Half (Unit-II)

2. (a) (i) How is the crystal field splitting energy for octahedral (Δ_0) and tetrahedral (Δ_t) complexes related?
(ii) Calculate the CFSE for d^7 metal ion for octahedral high spin and low spin complexes.

- (b) Answer any two:

- (i) Explain the violet colour of $[Ti(H_2O)_6]^{3+}$ complex on the basis of the crystal field theory.
(ii) Comment on the colour and magnetic moment of $[Mn(H_2O)_6]^{2+}$ and $MnCl_4^{2-}$ and explain the facts.
(iii) What differences do you expect between the molecular structures of *trans*- $[Co(en)_2F_2]^+$ and *trans*- $[Co(en)_2(CN)_2]^+$ ions?

(c) (i) Discuss the position of halides in spectrochemical series. (ii) Explain why Mn_3O_4 is a normal spinel whereas Fe_3O_4 is an inverse one.

(d) Give an example of these drugs (*any two*) with structures (i) Vanadium-based insulin mimic (ii) Platinum-based anti-cancer (iii) Gold-based medicine for treatment of rheumatoid arthritis.

(e) Discuss the role of following metal ions (*any one*) in human body (i) Ca (ii) Na

$$[(2+2)+(2+2)+(2+2)+(1\frac{1}{2}+1\frac{1}{2})+2]$$

2nd Half

3. (a) Show for an electrolyte, AB, transport number for ion A^{z+} , $t_A = \frac{U_A}{U_A + U_B}$. U_A and U_B are the ionic mobilities of the ions, A^{z+} and B^{z-} respectively.

OR

Using the concept of Ostwald's dilution law, derive the expression of dissociation constant for a weak electrolyte.

(b) What is equivalent conductance of solution and show its relation with molar conductance.

(c) How to find out molar conductance of CH_3COOH at infinite dilution (Λ_∞).

(d) Explain high conductance of OH^- ion in aqueous solution.

(e) Draw a typical conductometric titration curve between CH_3COOH (weak acid) and $NaOH$ (strong base) and explain the characteristics of the curve.

(f) Write down a working cell configuration with the following half-cells.

$$E_{Sn^{4+}/Sn^{2+}}^0 = 0.15 \text{ V} \text{ and } E_{Sn^{2+}/Sn}^0 = -0.136 \text{ V}$$

Further find out equilibrium constant value for the cell reaction.

OR

Describe the function of reversible and irreversible cells with suitable examples. Illustrate the function of saturated calomel electrode.

$$[3+2+2+2+3+4]$$