Motilal Nehru National Institute of Technology Allahabad, Prayagraj

Department of Chemistry

Mid Semester Examination 2022-23

B.Tech. I Semester

Chemistry (CY11103)

Time: 1.5 hours Maximum Marks: 20

Instructions: Attempts all questions and answer all the parts in given sequence.

---

1. (a) Discuss shapes and geometries of the following molecules on the basis of Valence Bond theory:

   (i) $HClO_3$ (ii) SO_3 [1 + 1]

   (b) Comment on the significance of molecular orbital theory and compare the stabilities of CO, CO^+ and CO^- species with suitable MO level diagram. [4]

   (c) Write and show all symmetry elements in eclipsed and staggered conformers of ethane molecule. [2+2]

2. (a) Dolomite and lime stone mining in the basins of the Indravati river is widely known in the Orissan district of Koraput. A number of families are residing along the river. They use the water from that river to wash their dishes and clothes. Their utensils' inner surface develops thick, sticky coatings of certain deposits over a period of time. The mineral salts that are left behind after washing cause soiled and dirty-looking garments. They frequently need to spend more money on buying soaps.

   i. If you had to name the thick coating of deposits on the inner surface of utensils, what would it be called and what would be its expected chemical composition? [1.5]

   ii. Give a strong justification for why they routinely spend more money on soap purchases? [1.5]

   iii. What mineral salts can be left behind on their clothing? [1]

   (b) The Yamuna River, India's capital New Delhi's artery was analysed for water, yielding the following findings: H_2SO_4 is present at a concentration of 392 mg/L along with $MgSO_4$ = 48 mg/L, $CaSO_4$ = 544 mg/L, NaCl = 250 mg/L, and SiO_2 = 8.4 mg/L. Nearly 32 million people in New Delhi receive water from the Yamuna. Only one lakh people will receive the daily recommended water consumption of 100 litres per person. Before serving the population for only one lakh, determine how much soda and lime is needed for water treatment. [3]

   (c) Calculate permanent and temporary hardness of water if 60 mL of hard standard water containing 1.5 g $CaCO_3$ per litre required 40 mL of EDTA solution for end point and 50 mL of water sample required 30 mL of EDTA solution, while the same amount of water after boiling required 20 mL EDTA solution. [3]

Motilal Nehru National Institute of Technology Allahabad, Prayagraj

Department of Chemistry

End-Semester Examination 2022-23

B.Tech. I Semester

Chemistry (CYN11503)

Time: 150 minutes | Maximum Marks: 40

Instructions: Attempt all questions and answer all the parts in given sequence.

---

1. a) 2.92 g of $Mg(HCO_3)_2$ was added to 2,000 litres of water stored in a tank. Calculate the degree of hardness (in degree French) and the amount of lime needed for treatment of 2000 litres of water (the possible reaction must be written). [3]

b) Sarita and Babita are two sisters who live in different cities. Sarita's water supplier drew water from a reservoir containing 2.40 ppm $MgSO_4$. On the other hand, Babita's city supplier collected reservoir water containing 2.96 ppm $Mg(NO_3)_2$. If both of them washed their clothes with 1000 litres of water individually per month, determine who is spending the most if Sarita uses Surf Excel bar of 100 g for Rs.10 per piece and Babita uses Nirma soap of 100 g for Rs. 5 per piece. [3]

2. a) How will you differentiate between cellulose and starch? Explain with proper structures and properties. [3]

b) What do you mean by vinyl based polymers? Which characterization technique will you use to identify vinyl acetate & methacrylate? Enumerate your answer with proper justification. [3]

c) The number average molecular weight of polymethyl methacrylate is 10000. Write chemical structure of the polymer, its degree of polymerization & application. [2]

3. a) Draw all the resonating structures of furan and discuss its substitution reactions with examples. [3]

b) Discuss the mechanism of Diels Alder reaction with two examples and comment on its stereo specificity. [2]

c) Define green chemistry. What do you mean by atom economy? [1]

d) Write and show all the symmetry elements present in 1,2-dichloroethene and acetylene. [2+2]

4. a) Consider dioxygen binding sites **M** which are mutually independent, non-interacting and moderately dilute solution of monomeric molecules. At what pressure (mm Hg) of dioxygen, 70% of **M** would be saturated by it? [Given that, 50% saturation of **M** occurs at 22 mm Hg of dioxygen] [4]

b) What is the composition of rectified spirit? Describe the method (with suitable reactions) for the preparation of absolute alcohol from rectified spirit. [4]

5. a) Explain chromatography and its essential components. [2]

b) Draw the classification chart for chromatographic techniques (it must include the mechanism, stationary phase, and mobile phase; any explanation is not required). [3]

c) Explain gas chromatography using a labelled diagram. [2+1]