Third Semester M.Sc. POLYMER CHEMISTRY

AN3C09/CH3C09/PO3C09 STRUCTURAL INORGANIC CHEMISTRY

(Common to M.Sc. Analytical Chemistry, Chemistry and Polymer Chemistry)

MODEL QUESTION PAPER

Time : 3 Hrs Max. Weights: 30

Section A

(*Answer any **10** questions. Each question carries a weight of **1***)

01. Briefly explain 'Perovskite' structure.
02. Explain Martensitic transformation with an example.
03. What is meant by sintering?
04. Define Piezoelectricity. Describe one application of Piezoelectric crystal.
05. Comment on the magnetic properties of 'Garnets'.
06. What are 'phosphors'? Explain its application in the working of fluorescent lamps.
07. Define 'Meissner effect'. Where does it find its applications?
08. Borazine is called inorganic benzene. Why?
09. Illustrate the role of Zeolites as supported metal catalysts.
10. The styx number of B_4H_{10} is (4012). Draw its topological structure.
11. Distinguish between closo, nido and arachno carboranes.
12. Discuss the preparation of Zintl anions and cations of Sn and Bi.
13. What are ceramic materials? Differentiate between traditional and advanced ceramics.

(10 x 1 =10 weights)

Section B

(*Answer any **5** questions. Each question carries a weight of **2***)

14. How will you distinguish between Fluorite and Antifluorite structures? Explain.
15. What are the factors influencing solid state reactions?
16. Explain the BCS theory of superconductivity.
17. What is photoconductivity? Give examples of photo conducting materials. How are photoconductors used for detection and measurement of radiation?
18. Explain the concept of heteropoly acids with special reference to Molybdenum.
19. Give a brief note on silicones and their applications.
20. Write a brief account of cage like structures of phosphorous.
21. What are safety glass and fibre glass? How are they made? What are their important uses?

(5 x 2 =10 weights)

Section C

(*Answer any **2** questions. Each question carries a weight of **5***)

22. (a) Discuss the structure of A_mX_2 and ABX_3 type crystals.
    (b) Discuss the kinetics of phase transitions in solids.

23. Discuss the salient features of classical free electron theory of metals. What are the drawbacks of free electron theory? How are these drawbacks rectified by the introduction of quantum Mechanical Treatment?

24. (a) Give an account of the structure of silicates.
    (b) Explain the structure and bonding in poly phosphazenes.

25. (a) How is $[Re_2Cl_8]^{2-}$ synthesized? Point out the characteristic features in bonding. Mention the evidence of M-M bond in it.
    (b) What is ceramic processing? Using a specific example, illustrate the use of sol-gel method in ceramic processing.

(2 x 5 =10 weights)

PH3C10/PO3C10 PHYSICAL CHEMISTRY
(common to Pharmaceutical Chemistry and Polymer Chemistry)
MODEL QUESTION PAPER

Time : 3 Hrs Max. Weight: 30

Section A

*(Answer any **10** questions. Each question carries a weight of **1**)*

01. Define steric factor. Explain how it is related to entropy of activation.
02. Explain with an example how NMR can be used in the study of fast reactions.
03. Compare transition state theory with collision theory.
04. Discuss primary kinetic salt effect.
05. What is cage effect?
06. Differentiate between sedimentation potential and streaming potential.
07. Discuss the effects of pH and temperature on catalysis.
08. Distinguish between excimers and exciplexes.
09. What is meant by photostationary state? Discuss with reference to formation of ozone in the atmosphere.
10. What is immunogold labelling?
11. What is Donnan membrane equilibrium?
12. Define zeta potential.
13. Explain the application of green chemistry in ibuprofen manufacture.

(10 x 1 =10 weights)

Section B

*(Answer any **5** questions by attempting not more than **3** questions from each bunch. Each question carries a weight of **2**)*

Bunch 1 (Short Essay Type)

14. What are explosive reactions? Explain the mechanism with a suitable example.
15. What are the principles of green chemistry?
16. Derive the Michaelis-Menten equation.
17. Discuss the kinetics of enzyme inhibition.

Bunch 2 (Problem Type)

18. A second order reaction has a rate constant k = 2.5 x 10^{-3} L mol^{-1} S^{-1} at 25°C. Its energy of activation is 48 kJ mol^{-1}. Calculate $\Delta S^{\neq}$ for the reaction, assuming that the reaction takes place in solution.
19. For a homogeneous gaseous reaction the rate constants are 3.0 x 10^{-5} L mol^{-1} S^{-1} and 1.2 x 10^{-3} L mol^{-1} S^{-1} at 629K and 700K respectively. Calculate the energy of activation and frequency parameter.

20. In a photochemical reaction $A \rightarrow 2B + C$ the quantum efficiency with 500 nm light is 2.1×10^2 mol Einstein^{-1}. After exposure of 300 m mol of A to the light 2.28 m mol of B was formed. How many photons were absorbed by A?

21. In an experiment to measure quantum efficiency of a photochemical reaction, the absorbing substance was exposed to 490 nm light from a 100W source for 45 minutes. The intensity of transmitted light was 40% of the intensity of the incident light. As a result of irradiation, 0.344 mol of the absorbing substance decomposed. Determine the quantum efficiency.

(5 x 2 =10 weights)

Section C

*(Answer any **2** questions. Each question carries a weight of **5**)*

22. a) Explain the BET theory of adsorption.
    b) Discuss the use of Langmuir and BET isotherms for surface area determination.

23. a) Explain the principles of ESCA and Auger electron spectroscopy.
    b) Discuss the applications of SEM and TEM in the study of surfaces.

24. a) Distinguish between E-type and P-type delayed fluorescence.
    b) Discuss the working of solar cells.
    c) Discuss the applications of LASER in the study of photochemical kinetics.

25. Give an account of the different types of nanomaterials and their applications.

(2 x 5 =10 weights)

PO3C11 CONCEPTS OF POLYMER HEMISTRY

MODEL QUESTION PAPER

Time: 3hrs Maximum Weight: 30

Section A

(*Answer any **10** questions. Each question carries a weight of **1***)

01. Write down the monomers and structure of the following polymers: SBR, thiokol rubber, MF, PC.
02. Explain why it is possible to synthesise two diisotactic polymer structures, but only one syndiotactic polymer structure.
03. Distinguish between isotactic, syndiotactic and atactic polymers.
04. What do you mean by PDI?
05. What are spiro polymers? Give an example.
06. Draw the structural formula indicating the stereoregular chain configuration in isotactic polypropylene.
07. Explain the terms crystallites and crystallizability.
08. How are polymer single crystals formed?
09. What do you mean by polymer fractionation?
10. Explain the causes for the numerous conformations of polymer chains.
11. Describe the fringed-micelle concept.
12. What is meant by Pearl-Model?
13. Write the expression for the entropy of mixing of polymers in solution.

(10 x 1 =10 weights)

Section B

(*Answer any **5** questions. Each question carries a weight of **2***)

14. Explain the term tacticity with suitable illustrations.
15. Write a note on compact molecules.
16. Discuss briefly the molecular forces in polymers.
17. Write a note on inorganic polymers.
18. What are the structural requirements for crystallinity?
19. Explain Hoffman's nucleation theory.
20. Explain Flory Krigbaum theory in detail.
21. Discuss briefly on scaling concepts.

(5 x 2 =10 weights)

Section C

(*Answer any **2** questions. Each question carries a weight of **5***)

22. Discuss the following (a) conformational transitions in polymers, (b) optically active poly(α-olefins) and (c) micro conformations in polymer solutions.
23. Describe the light scattering and viscometric methods for the determination of polymer molecular weight.
24. Explain the theory and application of XRD, SEM and DSC in determining the crystallinity of polymers.
25. Explain in detail Flory Huggins theory.

(2 x 5 =10 weights)

AN3C12/AP3C12/ CH3C12/ PH3C12/ PO3C12

SPECTROSCOPIC METHODS IN CHEMISTRY

(common to all branches of Chemistry)

MODEL QUESTION PAPER

Time: Three hours Total Weight: 30

Section A

*(Answer any **10** questions. Each question carries a weight of **1**)*

01. How would the fluorine NMR spectrum for F-CH_2-CO-CH_2-CH_3 appear?
02. How will you distinguish between $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions? Apply the effect of solvation to illustrate this.
03. Predict the signal pattern in DEPT-90 and DEPT- 135 spectra of phenyl acetic acid.
04. A trisubstituted benzene possessing one bromine and two methoxy substituents exhibits three aromatic resonance bands at 6.40, 6.46 and 7.41 ppm in its proton NMR spectrum. What is the substitution pattern?
05. Explain ORD with example.
06. What is meant by finger printing in IR spectroscopy?
07. How will you confirm the conversion of benzene to cyclohexane with ^{1}H NMR and ^{13}C NMR spectroscopy?
08. What is MALDI? Explain with example.
09. Comment on the differences between the scales in ^{1}H and ^{13}C NMR spectroscopy.
10. How will you estimate ring strain using IR and UV-Visible spectra.
11. Predict the proton and deuterium NMR spectra of D-CH_2-O-CH_3 (for D, I=1).
12. What are the applications of 2D- COSY spectra?
13. Sketch Karplus curve. Explain its characteristic features.

(10×1=10 weights)

Section B

*(Answer **5** questions. Each question carries a weight of **2**)*

14. Explain how IR spectroscopy can be applied to predict the product formation at each step in the following reaction series.

Benzaldehyde → Benzoin → Benzil → Benzilic acid.

15. Apply ^{1}H NMR and ^{13}C NMR spectroscopic techniques and explain how will you confirm the following conversions. Explain all characteristic features of the ^{1}H NMR and ^{13}C NMR of the substrates and the products.

a) CH_3-CH_2-CH_2-OH $\xrightarrow{[O]}$ CH_3- CH_2-CHO

b) CH_3-CH(OH)-CH_3 $\xrightarrow{[O]}$ CH_3-CO-CH_3

16. Sketch the H-H HOMOCOSY of (a) 2- chloro propane and (b) ethanol.
17. Write a note on (a) axial halo ketone rule and (b) Cotton effect.
18. Discuss the applications of HRMS and MS-MS techniques in structure analysis.
19. Define NOE. Explain Nuclear Overhauser Enhancement based on cross polarization theory.
20. Predict the structure of the compound with the following spectral characteristics:
    UV: 290 nm
    IR : 2980, 1718, 1440 cm^{-1}
    ^{1}H NMR : 2.3ppm (q), 2.15ppm(s), 1.1ppm(t)
    Mass (m/z) : 72(M^{+}), 43 (base peak), 29
21. Sketch the approximate ^{1}H NMR and ^{13}C NMR and mass spectra of 2-butenone. Explain the spectral features.

(5×2=10 weights)

Section C

*(Answer any **2** questions. Each question carries a weight of **5**)*

22. Define and explain spin-spin coupling. Using tree diagram method explain AX, AX_2, AX_3, A_2X_3, AB and ABC type coupling.

23. Write an essay on the application of DEPT, INEPT, and RINEPT in the structural elucidation of organic compounds. Illustrate the application of DEPT with examples.

24. (a). Predict the structure of the compound (commercial sample) with the following spectral characteristics and justify your answer.

    MF: $C_4H_{10}O$; IR: 3450 (broad), 2980, 1450, 1200, 1050cm^{-1}.
    ^{1}HNMR: 1.5 (3H, t), 2.8 (2H, dq), 3.4 (1H, m), 4.5 (1H, s), 2.1 (3H, d).
    ^{13}C NMR: 22.6, 68.7, 32.0, 9.9 ppm.
    DEPT 45: 4 signals, DEPT 90 : 1 signal, DEPT 135: 3 +ve and 1 –ve signals.

    (b). Discuss the theory and applications of MRI.

25. (a) An ester $C_5H_8O_2$ shows the following ^{13}C spectral results (off-resonance decoupled).

    20 ppm (q), 50 ppm (q), 126 ppm (t), 130 ppm (s) and 160 ppm (s).

    Predict the structure.

    (b) Determine the structure of the compound with the following spectral characteristics.

    MF: $C_5H_9NO_4$; IR: 1750, 1562, 1320$cm^{-1.}$
    ^{1}HNMR: 5.2 (q), 4.2 (q), 1.8 (d), 1.3 (t).

^{13}C (ppm)	PT 135	PT 90
		peak
		peak
		peak
	peak	peak

(2×5=10 weights)