FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2020

(CBCSS)

Polymer Chemistry

PCH 1C 04—POLYMER CHEMISTRY

(2019 Admissions)

Time : Three Hours   Maximum : 30 Weightage

General Instructions

1. *In cases where choices are provided, students can attend* **all** *questions in each section.*

2. *The minimum number of questions to be attended from the Section / Part shall remain the same.*

3. *There will be an overall ceiling for each Section / Part that is equivalent to the maximum weightage of the Section / Part.*

Section A

Answer any **eight** *questions.*
Each question carries a weightage of 1.

1. Name two inorganic polymers.

2. Give two examples for the polymers which are formed by carbonyl addition - substitution reaction.

3. What is the relationship between the number of free radicals produced and the number of quanta absorbed in photopolymerisation ?

4. What do you meant by redox initiation ?

5. What are thermoplastics ?

6. What do you meant by photodegradation of polymers ?

7. Give two examples for vinyl monomers.

8. What do you meant by degree of polymerisation ?

9. What is a graft copolymer ? Give example.

10. What are anti oxidants ?

11. Comment on ring opening polymerisation.

12. What do you meant by co-ordination chain polymerisation ?

(8 × 1 = 8 weightage)

Turn over

Section B

Answer any **four** *questions.*
Each question carries a weightage of 3.

13. What do you meant by interfacial condensation ? Give examples.

14. How will you get the entropy of polymerisation ?

15. Write down the mechanism of cationic polymerisation.

16. Discuss about Smith - Ewart kinetics.

17. Discuss about crosslinking after polymerisation.

18. What do you meant by chemical degradation of polymers ?

19. What are polymerisation reactors ?

$(4 \times 3 = 12 \text{ weightage})$

Section C

Answer any **two** *questions.*
Each question carries a weightage of 5.

20. (A) What do you meant by gelation ? How will you calculate the gel point of polymers ?

    (B) Briefly discuss about statistics of linear step - reaction polymerisation.

21. (A) What are copolymers ? Derive the copolymer equation.

    (B) Write note on rate of copolymerisation.

22. (A) How will you compare polymerisation in homogeneous and heterogeneous systems ?

    (B) Briefly discuss about the chemical reactions of polymers.

23. (A) What are the effect of temperature and pressure on chain polymerisation ?

    (B) Write notes on mechanism of vinyl polymerisation.

$(2 \times 5 = 10 \text{ weightage})$

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FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2020

(CBCSS)

Polymer Chemistry

PCH 1C 03—ORGANIC CHEMISTRY—I

(2019 Admissions)

Time : Three Hours   Maximum : 30 Weightage

Section A

Answer any **eight** *questions.*
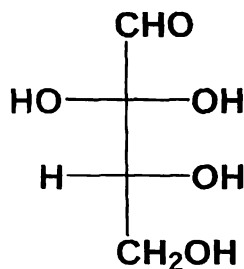*Each question carries a weight of 1.*

1. What are the basic criteria for a molecule to show aromaticity and antiaromaticity ?

2. Write a short note on the comparison of acidic strength of malice acid and fumaric acid.

3. What is hammet acidity function ?

4. Write the IUPAC name of the following compound (in terms of E and Z notations).
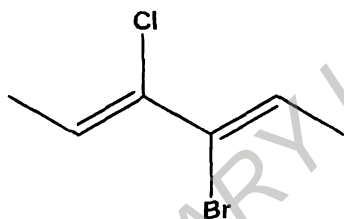
5. Write the R and S notation of second and third carbon atoms following compound :

Turn over
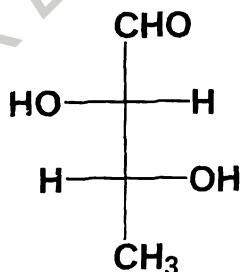
6. What is cram's rule ?

7. Write the structural formula of *Cis-1,2 dichlorocyclohexane.*

8. Define octant rule.

9. Draw the structure of second and third degenerate MOs $\left(\psi_2 \text{ and } \psi_3\right)$ of benzene molecule.

10. What is bond angle strain ?

11. Draw all the diastereomers and enantiomers of the following molecule :

12. What is a prochiral centre ?

$(8 \times 1 = 8 \text{ weightage})$

Section B

Answer any **four** *questions.*

Each question carries a weight of 3.

13. Write a note on the volatility, acidity, basicity and stability of hydrates of carbonyl compounds.

14. Explain atropisomers with suitable examples.

15. Explain axial haloketone rule and its significance.

16. Draw the Newman's formulae of all possible confirmations of n-butane molecule.

17. Explain clemmenson and wolf-kishner reduction with suitable reaction.

18. Explain the stereochemistry of S_N1 and S_N2 mechanisms.

19. Explain optical rotatory dispersion (ORD) and Circular Dichroism (CD).

$(4 \times 3 = 12 \text{ weightage})$

Section C

Answer any **two** *questions.*

Each question carries a weight of 5.

20. Write an essay on : (a) Inter and intra molecular hydrogen bonding ; and (b) MO description of aromaticity and antiaromaticity ?

21. Explain the sequence rule for R and S notations of acyclic and cyclic compounds.

22. Explain the following reactions with suitable molecules : (i) Aldol condensation ; (ii) Stobbe reaction ; and (iii) witting reaction.

23. Write an essay on electro organic reactions.

$(2 \times 5 = 10$ weightage$)$

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Name..

Reg. No...................................

FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2020

(CBCSS)

Polymer Chemistry

PCH 1C 02—INORGANIC CHEMISTRY-I

(2019 Admissions)

Time : Three Hours　　　　　　　　　　　　　　　Maximum : 30 Weightage

General Instructions

1. *In cases where choices are provided, students can attend **all** questions in each section.*

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3. *There will be an overall ceiling for each Section/Part that is equivalent to the maximum weightage of the Section/Part.*

Section A

*Answer any **eight** questions.*
Each question carries a weightage of 1.

1. Name the product obtained when diborane reacts with carbon monoxide.

2. What is the difference between Spectrochemical Series and Nephelauxetic Series ?

3. Identify the crystal classes that satisfy the Bravais lattice relations :

   (i) $a = b \neq c$ and $\alpha = \beta = Y = 90^o$ (ii) $a = b = c$ and $\alpha = \beta = Y \neq 90^o$.

4. Why do d3 complexes not show Jahn-Teller distortions ?

5. In a solid, oxide ions are arranged in CCP, cation A occupy one- sixth of the tetrahedral voids and cations B occupy one third of the octahedral voids. What is the formula of the compound ?

6. What is a polyoxyanion ?

7. What are the factors upon which reaction rate depends in the case of reaction between two solids ?

8. Potassium has the electronic configuration of [Ar]4s1. What are the possible term symbols of a neutral K atom ?

9. What is the difference between Latimer Diagram and Frost Diagram ?

10. Explain the stable oxidation states of lanthanides and actinides.

Turn over

11. Why are chelate complexes more stable ?

12. What is the co-ordination number of atoms in BCC, HCP, CCP and simple lattices ?

$(8 \times 1 = 8 \text{ weightage})$

Section B

*Answer any **four** questions.*
Each question carries a weightage of 3.

13. Explain the any two methods to synthesize diborane.

14. What are the characteristics of solid conductors ?

15. Discuss charge transfer transition in transition metal complexes.

16. Give a brief note on Fluorite structure.

17. Give a note on the classification of alloys with examples.

18. What is the difference between Crystal Field Theory and Ligand Field Theory ?

19. Strong bases are leveling solvents for acids, weak bases are differentiating solvents for acids. Explain

$(4 \times 3 = 12 \text{ weightage})$

Section C

*Answer any **two** questions.*
Each question carries a weightage of 5.

20. Predict the structure of B_5H_{11} using Wade's rule.

21. Explain what is Born Haber cycle and how it can be used to calculate the lattice energy of an ionic solid.

22. (i) Sketch the d-orbital energy levels and the distribution of d electrons in the complex ion $[Fe(Cl)6]3$-List the number of lone electrons, and label whether the complex is paramagnetic or diamagnetic.

    (ii) A tetrahedral complex absorbs at 545 nm. What is the respective octahedral crystal field splitting (Ao) ? What is the color of the complex ?

23. Explain the different types of defects in crystals.

$(2 \times 5 = 10 \text{ weightage})$

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FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2020

(CBCSS)

Polymer Chemistry

PCH 1C 01—THEORETICAL CHEMISTRY—I

(2019 Admissions)

Time : Three Hours　　　　　　　　　　　　　　　　　Maximum : 30 Weightage

General Instructions

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3. *There will be an overall ceiling for each Section/Part that is equivalent to the maximum weightage of the Section/Part.*

Section A

Answer any **eight** *questions.*
Each question carries a weight of 1.

1. Write down the ground state term symbol of carbon atom.

2. Write down the cyclic boundary condition required for a rigid rotator.

3. State expectation value postulate ?

4. Find the complex conjugate of :

　　(a)　-7.　　　　　　(b)　$7 + 4i$.

　　(c)　$-8i$.　　　　　　(d)　$e^{-i\pi}$.

5. What is Born-Oppenheimer approximation ?

6. Calculate the lowest energy of an electron in a ID box of side 15A°.

7. For the eigen function, where $m = 0, 1, 2, ...$, show that all solutions are mutually orthogonal.

8. What is Compton effect ?

9. Write down the possible spin and orbital functions for the electronic configuration $1s^1 2s^1$.

10. Normalize the wave function between the limits 0 and π.

Turn over

11. Choose the orbital with 2 radial and 2 angular nodes :

    (a) $3p$.   (b) $5f$.

    (c) $5d$.   (d) $8d$.

12. Write down any two major difference between VBT and MOT.

<div align="right">(8 × 1 = 8 weightage)</div>

Section B

*Answer any **four** questions.*
Each question carries a weight of 3.

13. Deduce the Schrödinger equation from classical wave equation.

14. Apply Schrödinger wave equation for particle in one dimensional box. Find eigen functions and eigen values.

15. Express in spherical polar coordinates.

16. The work function of metallic Fe is 5.8 eV. Calculate the kinetic energy of electrons from Fe surface when it is irradiated with a radiation of wavelength 350 nm.

17. Explain briefly the postulate of spin by Uhlenbeck and Goudsmith.

18. Find the ground state energy of He atom by first order perturbation method.

19. Briefly explain basic principles of HF method.

<div align="right">(4 × 3 = 12 weightage)</div>

Section C

*Answer any **two** questions.*
Each question carries a weight of 5.

20. State and prove variational theorem.

21. Explain the MO treatment of H^{2+} ion

22. Write down the Schrodinger equation for hydrogen atom in spherical polar co-ordinates, separate the variables and solve for the radial equation.

23. Write radial part of the Schrodinger wave equation for H atom. Find the solutions using Laguerre polynomials.

<div align="right">(2 × 5 = 10 weightage)</div>

FIRST SEMESTER M.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION NOVEMBER 2020

(CUCSS)

Polymer Chemistry

PC 1C 03—THEORETICAL CHEMISTRY I

(2010 Admissions)

Time : Three Hours   Maximum : 36 Weightage

Part A

*Answer **all** questions.*
Each question carries a weightage of 1.

1. Explain the characteristics of well-behaved wavefunctions.

2. What are eigen values ? Explain with an example.

3. Distinguish between normalized and orthogonal wavefunctions.

4. What is quantum tunnelling ? Explain with an example.

5. Explain space quantization of angular momentum.

6. What is spin ? How did Uhlenbeck and Goudsmith explain it ?

7. Explain the fine structure of the atomic spectrum of Hydrogen.

8. State and explain Pauli's exclusion principle.

9. Find the ground state atomic term symbol for carbon atom.

10. Write the spectroscopic term symbol for diboron molecule (ground state).

11. State and explain non-crossing rules for heteronuclear diatomics.

12. Explain Born-Openheimer approximation. What is its significance in quantum chemistry ?

13. Define free valence index. How will you calculate the free valence indices at the carbon atoms in ethylene ?

14. Explain the term Lennard Jones potential with suitable diagrams.

$(14 \times 1 = 14$ weightage$)$

Part B

*Answer any **seven** questions.*
Each question carries a weightage of 2.

15. (a) Define a Hermitian operator.

     (b) State the properties of a Hermitian operator.

Turn over

16. Deduce Schrödinger wave equation from classical wave equation.

17. (a) Define postulate.

    (b) Write the prominent postulates of quantum mechanics.

18. Derive the energy expression for a particle constrained to move in a onedimensional box.

19. How does a quantum harmonic oscillator differ from classical harmonic oscillator ?

20. (a) What are spherical harmonics ? Why do you call them so ?

    (b) Picturize any two of them using polar diagrams.

21. State and prove variation theorem.

22. Apply Independent-Particle model to the ground state of Helium atom.

23. Explain the significance of Frost-Huckel circle in Quantum Chemistry with examples.

24. Discuss ion-dipole and dipole-dipole interactions in chemistry with proper examples.

$(7 \times 2 = 14$ weightage$)$

Part C

Answer any **two** *questions.*
Each question carries a weightage of 4.

25. (a) Write Schrödinger wave equation for hydrogen atom in spherical polar coordinates.

    (b) Solve it by the method of separation of variables.

26. Discuss the general theory of perturbation method. Arrive atthe mathematical expressions of the first order correction to energy and wavefunction.

27. Write the essence of Molecular Orbital Theory (MOT). Apply MOT to hydrogen molecule ion.

28. (a) Write the basic principle of Hückel's Molecular Orbital theory (HMOT).

    (b) Apply HMOT to 1, 3-butadiene. Demonstrate how you will estimate the pi-electron energy and delocalization energy of this conjugated system.

$(2 \times 4 = 8$ weightage$)$

FIRST SEMESTER M.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION NOVEMBER 2020

(CUCSS)

Polymer Chemistry

PC 1C 02—ORGANIC CHEMISTRY–I

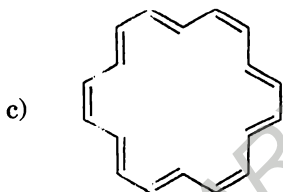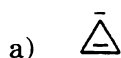(2010 Admissions)

Time : Three Hours   Maximum : 36 Weightage

Part A

*Answer **all** questions.*
Each question carries 1 weightage.

1. Draw the line diagram of hex-2, 4-diene. Give the possible stereoisomers.
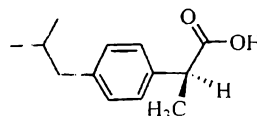
2. Which of them is/are aromatic ? Why ?

   a)   b)

   c)   d)
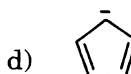
3. Account for the optical activity of spiranes and allenes.

4. Write notes on the significance of Taft equation.

5. How many conformations are possible for *trans*-decal-2-ol ? Draw them.

6. Explain antiaromaticity with a suitable example.

7. Assign absolute configuration for the following compounds :
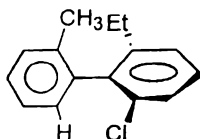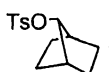
   a)   b)

Turn over

8. Draw the conformations of *cis*-1,3-dimethyl cyclohexane. Which is the most stable conformation ?

9. Why reacts with acetic acid 10^{11} times faster than .

10. Identify the product and propose a mechanism for its formation :
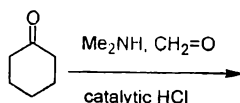
11. Briefly discuss electropolymerisation reaction. Give an instance in which it is highly useful.

12. Comment on the relative reactivity of HCHO, CH_3CHO, $(CH_3)_2CO$ and $(C_2H_5)_2CO$ towards nucleophilic addition reactions.
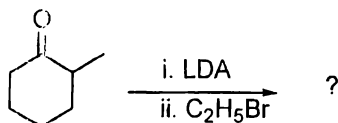
13. Predict the product and identify the reaction :
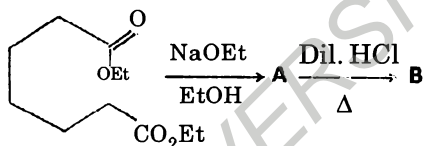
14. Compare the acidities of maleic acid and fumaric acid. Substantiate your answer.
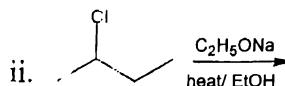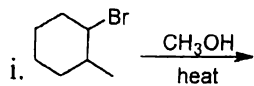
(14 × 1 = 14 weightage)

Part B

Answer any **seven** *questions.*
Each question carries 2 weightage.

15. Predict the major product formed in the following reactions and explain the reason :
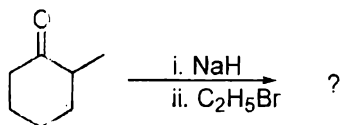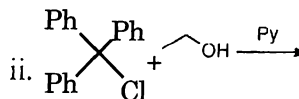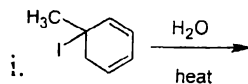
16. Predict the products and explain :
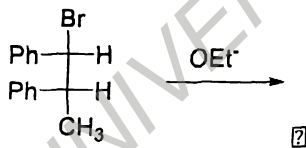
   a)

   b)

17. Briefly discuss with mechanism :

   a) Wolf Kishner Reduction.

   b) Unimolecular elimination reaction (E1).

18. Comment on the stereochemistry of the product obtained in the following reaction :

19. Explain axial, planar and helical chirality with examples.

20. Give a note on primary kinetic isotopic effect with suitable example.

21. Define Huckel's rule and discuss the aromaticity of annulenes.

22. Mechanistically illustrate : a) MPV reduction ; b) Ritter reaction.

23. o-bromo toluene and m-bromo toluene gives the same product upon reaction with $NaNH_2$ in liquid NH_3. Give the reason with equation.

24. Illustrate the utility of electrochemical oxidation and reduction reactions in comparison with normal oxidation and reduction reactions.

(7 × 2 = 14 weightage)

Turn over

Part C

Answer any **two** *questions.*
Each question carries 4 weightage.

25. Explain briefly on the effects of substrate and leaving group on nucleophilic substitution reactions.

26. Account for the effect of conformation on dehalogenation and dehydrohalogenation reactions.

27. Mechanistically illustrate and discuss the utility of :

   a) Wittig Reaction.

   b) Stobbe Condensation.

   c) Prins Reaction.

   d) Chichibabin Reaction.

28. a) Write a note on the topicity of ligands.

   b) Discuss CIP rules for R-S nomenclature.

(2 × 4 = 8 weightage)

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2019

(CUCSS)

Polymer Chemistry

PC1C01—INORGANIC CHEMISTRY—I

(2010 Admissions)

Time : Three Hours   Maximum : 36 Weightage

Part A

*Answer **all** questions.*
Each question carries 1 weightage.

1. Define an acid and a base according to Arrhenius and Lewis concept. Give suitable examples.

2. What is meant by levelling effect ?

3. Classify the following as closo, nido and arachno : (i) $B_{10}H_{14}$; (ii) B_5H_{11} ; (iii) $C_2H_{10}H_{12}$.

4. How many Bravais lattices are there ? What are they ?

5. What are carbides ? How do we classify them ?

6. Write a note on Hume-Rothery rules.

7. What is Fermi energy ?

8. What is Q value ? Write its importance in nuclear chemistry.

9. Distinguish between nuclear fission and nuclear fusion reactions.

10. Discuss briefly the theory of adsorption indicators.

11. State and explain Jahn-Teller effect.

12. Write notes on Ellingham diagram.

13. Account for the colour exhibited by the lanthanide compounds.

14. Actinides have greater tendency to form complexes that lanthanides. Explain.

(14 × 1 = 14 weightage)

Part B

*Answer any **seven** questions.*
Each question carries 2 weightage.

15. Write notes on the chemistry of liquid ammonia as a solvent. What are their advantageous and disadvantageous ?

16. Discuss the nature of bonding involved in B_2H_6 and B_4H_{10}.

Turn over

17. What are silicones ? Describe their structures and applications.

18. Explain the structure of the following with diagrams : (i) CaF_2 ; (ii) Rutile ; and (iii) Perovskite.

19. Discuss the Born-Haber cycle for experimental determination of lattice energy.

20. What is meant by the term confidence limit ? How is it determined ? What is its significance ?

21. What is nephelauxetic effect ? How does this effect explain the contribution of covalent bonding in metal-ligand bonds ?

22. Define crystal field stabilization energy. Calculate its value for the following systems (i) d^5 low spin octahedral ; (ii) d^4 tetrahedral ; (iii) d^5 high spin octahedral ; and (iv) d^6 tetrahedral.

23. Discuss the crystal field splitting of d orbitals in tetrahedral and square planar complexes.

24. What is lanthanide contraction ? What are its important consequences ? Would you expect analogous actinide contraction ?

(7 × 2 = 14 weightage)

Part C

*Answer any **two** questions.*
Each question carries 4 weightage.

25. Discuss the stoichiometric and non-stoichiometric defects in crystals. Mention the consequences of these defects in crystals.

26. Explain the following : (i) Tracer Techniques ; (ii) Rock dating ; (iii) Carbon dating ; (iv) Neutron activation analysis.

27. Discuss sigma and pi bonding in square planar complexes by constructing a composite molecular orbital diagram for $[PtCl_4]^{2-}$.

28 (a) What are the problems in the separation of lanthanides from one another ? Discuss the ion exchange method for the separation of lanthanides.

(b) Discuss the chemistry of various steps involved in the extraction of Thorium from monazite sand and of Uranium from Pitchblende.

(2 × 4 = 8 weightage)