

(8 pages)

Reg. No. : .....

Code No. : 6053

Sub. Code : PCHM 31

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Third Semester

Chemistry – Core

ORGANIC CHEMISTRY – III

(For those who joined in July 2017-2020 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer.

1. Which among the following alcohols will give E1 reaction?
  - (a)  $\text{CH}_3 - \text{C}(\text{CH}_3)_2 - \text{CH}_2\text{OH}$
  - (b)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{OH}$
  - (c)  $\text{CH}_3 - \text{CH}(\text{OH}) - \text{CH}_3$
  - (d)  $\text{CH}_3 - \text{CH}_2 - \text{OH}$

2. The order of nucleophilicity of the halides in non-polar solvents is
- (a)  $I^- > Br^- = Cl^- > F^-$
  - (b)  $F^- > Cl^- > Br^- > I^-$
  - (c)  $I^- > Br^- > Cl^- > F^-$
  - (d)  $I^- < Br^- > Cl^- > F^-$
3. Pick the correct statement regarding geminal coupling
- (a) Electron donation makes the coupling less positive
  - (b) Electron withdrawal group makes the J more positive
  - (c) Geminal coupling constant usually have negative J values.
  - (d) As the dihedral angle decreases the  $J_{gem}$  decreases
4. Which among the following technique exhibits  $^{13}C - ^{13}C$  correlations.
- (a) INADEQUATE      (b) INEPT
  - (c) HMBC              (d) DEPT

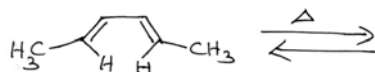
5. The minimum energy required for the appearance of fragment ion is known as its \_\_\_\_\_ potential.

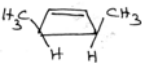
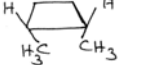
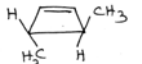
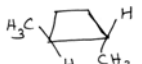
- (a) Reduction                      (b) Appearance  
(c) Condensation                  (d) Ionization

6. Separation of the ions on the basis of their mass/charge value takes place in the \_\_\_\_\_.

- (a) collector slits                  (b) Amplifier  
(c) Analyzer                          (d) Recorder

7. Predict the product of the following reaction.



- (a)  (b)   
(c)  (d) 

8. Photochemical reaction involving fission of  $\alpha$ - carbon and carbonylic carbon followed by elimination is known as \_\_\_\_\_.

- (a) Photo reduction                  (b) Norrish type - II  
(c) Norrish type-I                      (d) None of the above

9. In indole the electrophilic substitution occurs at \_\_\_\_\_.

(a) C-4 (b) C-5

(c) C-6 (d) C-3

10. Which of the following is the degradation product of pyrimidines?

(a) Glycine (b) Allantoin

(c) Uric acid (d) Beta-alanine

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) Explain the mechanism with evidence of  $S_Ni$  reaction.

Or

(b) (i) Write a note on nucleophilic substitution at a vinylic carbon.

(ii) What are ambident nucleophiles? Give an example.

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[P.T.O.]

12. (a) Explain the uses of 2D NMR spectra. What are the advantages of COSY spectra? Explain with an example.

Or

- (b) (i) What do you mean by proton exchange reactions? How does spin decoupling occur in certain groups due to proton exchange?
- (ii) Why greater sensitivity is required to record  $^{13}\text{C}$  NMR spectra compared to that of  $^1\text{H}$  NMR spectra?

13. (a) How to interpret MALDI-MS spectra?

Or

- (b) Explain the following terms in mass spectrometry.
- (i) Parent ion peak, (ii) Meta stable peak

14. (a) (i) Discuss the mechanism of photochemical Cis-trans isomerisation.
- (ii) What is meant by inter system crossing?

Or

- (b) Discuss the FMO approach to [2+2] and cycloadditions.

15. (a) Write briefly on biosynthesis of flavonoids.

Or

(b) Outline a synthesis of each of the following:

(i) Oxazole (ii) Pyrazine

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) (i) What is NGP? Explain the role of C=C  
S and halogen as NGP with suitable  
examples.

(ii) Illustrate Chugaev reaction.

Or

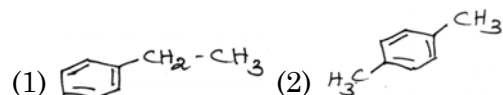
(b) (i) Narrate the B<sub>AC</sub> 2 mechanism with a  
suitable example.

(ii) Account for the orientation of the  
double bond in E2 elimination under  
Hofmann and Saytzeff conditions (one  
example for each).

17. (a) (i) Write a short note on Nuclear Overhauser effect.  
(ii) Write briefly about OFF-resonance decoupled  $^{13}\text{C}$  spectroscopy.

Or

- (b) (i) Explain the chemical shift and what are the factors affecting the chemical shift.  
(ii) How will you distinguish the following compounds with help of  $^{13}\text{C}$  NMR?



18. (a) Write a short note on:  
(i) Isotopic peak  
(ii) Mc lafferty rearrangement

Or

- (b) A compound with a molecular formula of  $\text{C}_{10}\text{H}_{12}\text{O}_2$  showed the following spectral properties.

UV (cyclohexane)  $\lambda_{max}$  : 230nm and 273 nm.

IR ( $\text{CHCl}_3$ ) :  $1715\text{cm}^{-1}$

$^1\text{H}$  NMR ( $\text{CDCl}_3/\text{TMS}$ )  $\delta$  values : 1.1 (d,6H)

3.8 (septet, 1H) and 7.2 (m,5H).

The compound on hydrolysis with base furnished an acid a molecular formula of  $\text{C}_7\text{H}_6\text{O}_2$ . Assign a suitable structure for the compound.

19. (a) Write notes on:
- (i) Photosensitization
  - (ii) Norrish type II cleavages.

Or

- (b) (i) What do you understand from the order [i,j] of sigmatropic rearrangement? Explain with an example.
- (ii) Describe the Paterno-Buchi reaction.

20. (a) Discuss the structure of maltose.

Or

- (b) (i) Give a method of synthesis of (I) Thiazole and (II) coumarin.
- (ii) How is the ring size in glucose determined?

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(6 pages)

Reg. No. : .....

**Code No. : 6055**

**Sub. Code : PCHM 33**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Third Semester

Chemistry — Core

PHYSICAL CHEMISTRY - III

(For those who joined in July 2017-2020 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Matrix multiplication is a/an \_\_\_\_\_ property.  
(a) Commutative            (b) Associative  
(c) Additive                (d) Disjunctive
2. The symmetry point group of water is \_\_\_\_\_.  
(a)  $C_{3h}$                       (b)  $C_{4v}$   
(c)  $C_{2v}$                         (d)  $D_{6h}$

3. Which of the following modes of vibration will be Raman and IR active in H<sub>2</sub>O molecule?
- (a) Symm. stretch                      (b) Asym.Stretch  
(c) Bending vibration                  (d) All the above
4. Fermi resonance is a common phenomenon in \_\_\_\_\_.
- (a) Raman spectra                      (b) IR spectra  
(c) CO<sub>2</sub>                                      (d) All the above
5. Chemical shifts originate from \_\_\_\_\_.
- (a) Magnetic momentum  
(b) Electron shielding  
(c) Free induction decay  
(d) Scalar coupling (J-coupling)
6. The natural abundance of <sup>13</sup>C is about \_\_\_\_\_.
- (a) Four times less than <sup>1</sup>H  
(b) 0.11% of total carbon  
(c) 1.1% of total carbon  
(d) 99% of total carbon

7. Which of the following is used as detector crystal in EPR spectrometer?
- (a) Silicon rectifier
  - (b) Silicon tungsten rectifier
  - (c) Silicon boron rectifier
  - (d) Silicon quartz rectifier
8. Nuclear quadrupole resonance spectroscopy or NQR is a chemical analysis technique related to \_\_\_\_\_.
- (a) NQIR
  - (b) FTIR
  - (c) NMR
  - (d) EPR
9. Most application of Mössbauer spectrometry in materials science utilize \_\_\_\_\_ in which the electrons around a nucleus perturb the energies of nuclear states.
- (a) hyperfine interactions
  - (b) Recoil energy
  - (c) Quadrupole interactions
  - (d) Isomer shift

10. The base peak in a mass spectrum is \_\_\_\_\_.
- (a) the peak set to 100% relative intensity
  - (b) the lowest mass peak
  - (c) the peak corresponding to the parent ion
  - (d) the highest mass peak

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).  
Each answer should not exceed 250 words.

11. (a) Explain the Great Orthogonality theorem.

Or

- (b) What is meant by symmetry elements and symmetry operations?

12. (a) Write the rule of mutual exclusion principle for CO<sub>2</sub> molecule.

Or

- (b) Brief about the vibrational energies of diatomic molecules.

13. (a) What is chemical shift? What are the factors influencing chemical shift?

Or

- (b) Explain the Nuclear Overhauser effect.

14. (a) What is hyperfine splitting in ESR? Explain with an example.

Or

- (b) Write the basic principles and applications of NQR.

15. (a) Explain the quadrupole effects in Mössbauer spectra.

Or

- (b) Discuss the isomer shift in Mössbauer spectroscopy.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

Each answer should not exceed 600 words.

16. (a) Construct a character table for  $C_{3v}$  point group by taking  $NH_3$  as an example.

Or

- (b) Discuss the Reducible representation and irreducible representations.

17. (a) Calculate the delocalization energy for trans-1,3-butadiene using HMO theory.

Or

- (b) Give the comparison of symmetry selection rules for infrared and Raman spectra.

18. (a) Discuss the general principles of two dimensional (2D) NMR.

Or

- (b) Give a comprehensive note on  $^{13}\text{C}$  NMR spectroscopy.

19. (a) Give an account on Kramer's degeneracy and Zero field splitting. Explain, how these phenomenon applies in the spectra of Mn (II).

Or

- (b) Give the EPR spectra of the methyl radical and benzene anion radical.

20. (a) State the principle of x-ray photoelectron spectroscopy. Outline the applications of ESCA.

Or

- (b) Give a brief account on rotational fine structure and origin of Fortrat parabola in electronic spectroscopy.
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(6 pages)

Reg. No. : .....

**Code No.: 6057**

**Sub. Code: PCHM 41**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022

Fourth Semester

Chemistry – Core

ORGANIC CHEMISTRY – IV

(For those who joined in July 2017-2020)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. In Shapiro reaction a ————— mechanism is possible.  
(a) carbene                      (b) anion  
(c) radical                        (d) ylide





6. Tetra hydro pyranyl is a protecting group for \_\_\_\_\_.
- (a) amine                      (b) carbonyl  
(c) alcohol                      (d) acids
7. DDQ is a powerful \_\_\_\_\_ agent.
- (a) reducing                      (b) nitrating  
(c) oxidising                      (d) Decarboxylating
8. Stille reaction is coupling of two organic groups in the presence of palladium with \_\_\_\_\_.
- (a) organolithium              (b) organosilane  
(c) organomagnesium      (d) organostannanes
9. When concentrated sulphuric acid is added to a solution of cholesterol in chloroform a \_\_\_\_\_ colour is produced in chloroform layer.
- (a) green                      (b) blue  
(c) red                      (d) yellow
10. Catalytic hydrogenation of ergosterol produces \_\_\_\_\_.
- (a) Calciferol                      (b) Cholesterol  
(c) Stigmasterol                      (d) Ergostano

PART B — (5 × 5 = 25 marks)

Answer ALL questions by choosing either (a) or (b).

11. (a) Explain the mechanism of Stobbe reaction.

Or

- (b) Suggest the mechanism for Wittig reaction and discuss its uses.

12. (a) Outline the conformational analysis of Cis -1, 2, -dimethyl cyclohexane.

Or

- (b) Axial cyclohexanol is oxidized faster than equatorial cyclohexanol. Justify your answer.

13. (a) Give an overview of protecting groups used to protect amine compounds.

Or

- (b) How is Robinson annulation reaction useful in organic synthesis?

14. (a) Summarize the synthetic applications of organosilanes.

Or

- (b) Explain the preparation and applications of DDQ.

15. (a) How is cestrone converted to oestriol.

Or

(b) Suggest a method to prepare  $5\alpha$ -cholanic acid from cholesterol.

PART C — ( $5 \times 8 = 40$  marks)

Answer ALL questions by choosing either (a) or (b).

16. (a) Discuss the mechanism of Julia olefination and acyloin condensation.

Or

(b) Suggest the mechanism for Mc Murray coupling and Pschorr reactions.

17. (a) Establish the conformational analysis of decalin.

Or

(b) Discuss Curtin Hammett principle.

18. (a) Compose the retrosynthetic analysis of Cis-Jasmone and designed synthesis.

Or

(b) Discuss functional group inter conversion with suitable examples.

19. (a) Compile the synthetic applications of samarium in organic synthesis.

Or

(b) Describe the preparation and synthetic applications of Adams catalyst.

20. (a) How do you establish the following in the structure of cholesterol?

(i) position of the side chain

(ii) position of the angular methyl group

Or

(b) Elaborate on the general study of bile acids.

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(6 pages)

Reg. No. : .....

Code No. : 6058

Sub. Code : PCHM 42

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Fourth Semester

Chemistry – Core

INORGANIC CHEMISTRY – IV

(For those who joined in July 2017-2020)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. \_\_\_\_\_ is the shift on atomic spectral lines and gamma spectral lines, which occurs as a consequence of replacement of one nuclear isomer by another.
  - (a) Chemical shift
  - (b) Red shift
  - (c) Blue shift
  - (d) Isomer shift

2. Mossbauer spectroscopy arises due to the transition of \_\_\_\_\_
- (a) Vibrational                      (b) Nuclear spin  
(c) Rotational                      (d) Electronic spin
3. Which of the following is also known as X-ray photoelectron spectroscopy?
- (a) Electron spectroscopy for chemical analysis  
(b) Auger electron spectroscopy  
(c) Both (a) and (b)  
(d) Electron impact spectroscopy
4. \_\_\_\_\_ spectroscopy is a branch of magnetic resonance spectroscopy and is concerned with the absorption of radio waves by matter in zero magnetic field.
- (a) NMR                                  (b) EPR  
(c) NQR                                  (d) Raman
5. Ferritin and transferrin are \_\_\_\_\_.
- (a) hydrolyses  
(b) metal storage and structural proteins  
(c) electron carriers  
(d) metal sensors

6. The function of myoglobin is \_\_\_\_\_.
- (a) Storage of CO<sub>2</sub>      (b) Storage of CO  
(c) Storage of O<sub>2</sub>      (d) Storage of NO
7. In oxygen transport element which is important?
- (a) Fe and Cu      (b) Fe and CO  
(c) Fe and Mg      (d) Fe and Mn
8. \_\_\_\_\_ is an enzyme that helps break down potentially harmful oxygen molecules in cells.
- (a) Superoxide dismutase  
(b) Carboxypeptidase  
(c) Carbonic anhydrase  
(d) Xanthine oxidase
9. Zirconia is a hard brittle \_\_\_\_\_.
- (a) Metal      (b) Non-metal  
(c) Ceramics      (d) Composite
10. How many tubes of graphite do single-walled nanotubes consist of?
- (a) Two      (b) One  
(c) Three      (d) Multi

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Explain the quadrupole effect of magnetic field on Mossbauer spectra.

Or

- (b) How will you determine the absolute configuration of complexes?

12. (a) Write the principle and applications of Auger Electron spectroscopy.

Or

- (b) Write the Koopman's theorem. Explain with an example.

13. (a) Explain the structure and function of chlorophyll.

Or

- (b) Write the role of metal ions in biological systems.

14. (a) Write a brief note on superoxide dismutase.

Or

- (b) Describe the role of the Carbonic anhydrase in biological systems.



15. (a) What are zeolites? Give its structure and properties.

Or

- (b) Write a comprehensive note on graphite compounds.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) What do you mean by isomer shift? Discuss the Mossbauer spectra of iron (Sn) compounds.

Or

- (b) Discuss the hyperfine splitting in Mossbauer spectra.

17. (a) Write a note on adiabatic and vertical ionisation.

Or

- (b) Discuss the basic principles and applications of nuclear quadrupole resonance spectroscopy (NQR).

18. (a) Write a note on Perutz mechanism.

Or

(b) Write a comprehensive note on Ferredoxins and rubredoxins.

19. (a) Give a brief account on copper proteins.

Or

(b) Discuss the role of metallothioneins in bioinorganic chemistry.

20. (a) Brief about the fullerenes in supramolecular chemistry.

Or

(b) How will you synthesis Nanoparticles using sol-gel method and hydrothermal methods?

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(7 pages)

Reg. No. : .....

**Code No. : 6059**

**Sub. Code : PCHM 43**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Fourth Semester

Chemistry – Core

PHYSICAL CHEMISTRY – IV

(For those who joined in July 2017-2020)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. On which factors the vibrational stretching frequency of diatomic molecule depend?
  - (a) Force constant
  - (b) Atomic Population
  - (c) Temperature
  - (d) Magnetic Field

2. Which of the following molecules will not exhibit an infrared spectrum?
- (a)  $\text{CO}_2$                       (b)  $\text{N}_2$
- (c) Benzene                      (d)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$
3. In Raman spectrum, if  $\lambda$  is the wavelength of incident radiation, then the Anti-Stoke's lines will have wavelength equal to
- (a)  $\lambda$                       (b)  $\lambda + \Delta\lambda$
- (c)  $\lambda - \Delta\lambda$                       (d)  $\lambda^2$
4. Which of these properties must change for a mode to be Raman active?
- (a) Volume                      (b) Polarisability
- (c) Momentum                      (d) Dipole moment
5. Flash photolysis can be used to study free radicals with concentration
- (a)  $10^{-1}\text{M}$                       (b)  $10^{-2}\text{M}$
- (c)  $10^{-3}\text{M}$                       (d)  $10^{-6}\text{M}$

6. The minimum additional energy, above the internal energy, which the reacting molecule must possess so that their collision results in a reaction is known as
- (a) Threshold energy
  - (b) Average Potential Energy
  - (c) Average Kinetic Energy
  - (d) Activation Energy
7. Explosive reactions are the type of
- (a) Fast reactions            (b) Chain reactions
  - (c) Slow reactions            (d) Surface reactions
8. Effect of ionic strength is
- (a) Ionic effect                (b) Electrophoretic effect
  - (c) Salt effect                 (d) Solvent effect
9. The magnitude of chemisorptions increases with \_\_\_\_\_ temperature
- (a) Rise in                      (b) Decrease in
  - (c) Constant                    (d) Low
10. The transition of ions to micelle is
- (a) Reversible                 (b) Irreversible
  - (c) Both (a) and (b)         (d) Neither (a) nor (b)

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Homonuclear diatomic molecules do not show vibrational spectra. Explain why?

Or

- (b) Explain Born-Oppenheimer approximation.

12. (a) State selection rules for Raman spectra. Consider the molecular vibrations of carbon dioxide and determine Raman active vibrational modes.

Or

- (b) Why are the anti-stokes lines less intense than stokes lines in Raman spectrum? Explain how the laser source of exciting radiation helped in Raman spectroscopy.

13. (a) Discuss the simple collision theory.

Or

- (b) Explain briefly the salient features of RRKM theory of unimolecular reactions.

14. (a) Give the significance of volume of activation.

Or

(b) Write notes on Hammett equation. Mention its significance.

15. (a) Derive Langmuir isotherm equation.

Or

(b) How is the surface area of a catalyst determined by employing B.E.T. adsorption equation?

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

Each answer should not exceed 600 words.

16. (a) Explain the terms :

- (i) Overtones
- (ii) Combination of bands
- (iii) Selection rules for IR spectra
- (iv) Born-Oppenheimer approximation.

Or

(b) How many normal modes of vibration are possible for the following molecules?

- (i)  $\text{BCl}_3$
- (ii)  $\text{HC} \equiv \text{CH}$
- (iii)  $\text{CH}_3\text{I}$
- (iv)  $\text{C}_6\text{H}_6$ .

17. (a) Explain :
- (i) Q-switching
  - (ii) Types of Lasers.

Or

- (b) Discuss the applications of IR and Raman spectroscopy.
18. (a) Discuss the salient features of ARR theory and write its thermodynamic formulation.

Or

- (b) How will you explain Nuclear Magnetic Resonance method for the study of Fast reactions?
19. (a) Explain the factors influencing reaction rates in solution.

Or

- (b) Discuss the influence of pressure on explosion in the reaction between  $H_2$  and  $O_2$ .



20. (a) Derive B.E.T. adsorption isotherm.

Or

(b) (i) Explain Bronsted catalysis law.

(ii) Explain the kinetics and mechanism of acid-base catalysis reaction.

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(6 pages)

Reg. No. : .....

Code No. : 6395

Sub. Code : ZCHM 11

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022

First Semester

Chemistry – Core

AROMATICITY AND ORGANIC REACTION  
MECHANISM

(For those who joined in July 2021 onwards)


Time : Three hours

Maximum : 75 marks

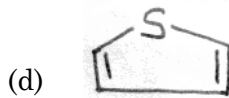
PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The IUPAC name of  is
- (a) Bicyclo [0.1.2] pentane
  - (b) Bicyclo [1.0.2] pentane
  - (c) Bicyclo [1.0.1] pentane
  - (d) Bicyclo [2.1.0] pentane

2. Which of the following compounds is not aromatic?



3. What should be the free energy so that reaction is spontaneous?

(a) Positive

(b) Negative

(c) Neutral

(d) none of the mentioned

4. In Hammett constituent constant  $\sigma_p$  is negative for substituted benzoic acid is \_\_\_\_\_ then benzoic acid itself.

(a) more acidic

(b) neutral

(c) more basic

(d) less acidic

5. Carbenes are trapped as

(a) Cyclopropane derivative

(b) Oxidative product

(c) Diels Alder reaction

(d) Hydroxylamine derivative

6. By which of the following techniques, free radicals can be detected
- (a) UV                                  (b) NMR  
(c) IR                                  (d) ESR
7. In the E1 mechanism, the leaving group leaves first to generate a \_\_\_\_\_
- (a) Free radical                      (b) Carbene  
(c) Carbocation                      (d) Carbanion
8. E1cB elimination reaction occurs under \_\_\_\_\_ conditions.
- (a) Neutral                              (b) Basic  
(c) Less acidic                        (d) More acidic
9. The best medium for Mannich reaction is \_\_\_\_\_
- (a) Acidic                                (b) Aqueous  
(c) Basic                                 (d) Organic
10. Why is sodium borohydride an important reagent in reducing a ketone?
- (a) It is good for hydrolysis type reactions  
(b) It is a good source of the hydride ion (H<sup>-</sup>)  
(c) It can act as a base  
(d) It can act as a free radical initiator

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Narrate the aromaticity of annulenes.

Or

- (b) Discuss the homo and anti-aromaticity in  $2\pi$  and  $8\pi$  electron systems.

12. (a) Write a brief account on Yukawa – Tsuno equation.

Or

- (b) Write a note on Grunwald – Winstein equation.

13. (a) What are singlet and triplet carbenes? How do they react with alkenes?

Or

- (b) Discuss the formation and stability of free radicals.

14. (a) Explain the role of neighbouring group participation with examples.

Or

- (b) How does nucleophilic substitution take place at vinylic carbon? Illustrate with examples.

15. (a) How is benzyne intermediate generated?  
Write two of its important properties.

Or

- (b) Write briefly on Michael addition.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Discuss the structure and synthesis of congressane.

Or

- (b) (i) Explain the structure of azulene.  
(ii) How can adamantane be synthesized?  
(iii) How are sydnones synthesized?

17. (a) (i) State and explain the principle of microscopic reversibility.  
(ii) How are cross-over experiments useful in determining reaction mechanism?

Or

- (b) (i) With an example show how isotopic labelling can be used to ascertain the mechanism.  
(ii) Why is Hammett equation a linear free energy relationship?

18. (a) (i) What is Hofmann-Löffler reaction?  
Discuss its mechanism.  
(ii) Narrate the stability of carbenes.

Or

- (b) Give in detail the methods of generations and reactions of nitrene.
19. (a) Explain the mechanism and stereo chemistry of E2 reaction.

Or

- (b) (i) What are Saytzeff and Hoffmann orientations? Explain with examples.  
(ii) Write a note on ambident nucleophile.
20. (a) Discuss in detail the mechanism of ortho-lithiation reaction and its applications.

Or

- (b) Briefly discuss the following :
- (i) Birch reduction  
(ii) Wittig reaction.
-

(7 pages)

Reg. No. : .....

**Code No. : 6396**

**Sub. Code : ZCHM 12**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

First Semester

Chemistry — Core

FUNDAMENTALS OF INORGANIC CHEMISTRY,  
NUCLEAR CHEMISTRY AND INORGANIC  
POLYMERS

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Dipole – dipole forces are stronger than \_\_\_\_\_ and weaker than \_\_\_\_\_ interactions
  - (a) Ion – ion, London
  - (b) London, ion - ion
  - (c) Ion – ion, dispersion
  - (d) Dipole – induced dipole, London



2. Due to the repulsive forces the potential energy of the system is \_\_\_\_\_
- (a) increased
  - (b) decreased
  - (c) increased and decreased
  - (d) none of these
3. Carbon monoxide has ten bonding electrons and four antibonding electrons. Therefore it has a bond order of \_\_\_\_\_
- (a) 2
  - (b) 3
  - (c) 7
  - (d) 1
4. Which one of the following is not paramagnetic?
- (a)  $O_2^-$
  - (b)  $CO$
  - (c)  $N_2^+$
  - (d)  $NO$
5. Which of the following compound is most acidic?
- (a)  $B_2O_3$
  - (b)  $SO_3$
  - (c)  $P_4O_{10}$
  - (d)  $Cl_2O_7$
6. Which of the following is non-aqueous solvent?
- (a)  $CCl_4$
  - (b) Ether
  - (c) Benzene
  - (d) All of these

7. In which of the following process are neutrons emitted?
- (a) Nuclear fusion      (b) Nuclear fission  
(c) Spontaneous fission (d) Inverse beta decay
8. A compound containing some amount of radio isotope is \_\_\_\_\_
- (a) Radio active compound  
(b) Tracer  
(c) Non-radioactive  
(d) Linear active compound
9. Which of the following compound exists in liquid state?
- (a) Borane                      (b) Decaborane  
(c) Pentaborane              (d) Diborane
10. Which element exhibits the highest catenation property?
- (a) Bismuth                      (b) Antimony  
(c) Phosphorus                (d) Nitrogen

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Give a concise account on the applications of Slater rules.

Or

- (b) Give a brief account on the factors affecting redox potential.

12. (a) Draw the molecular orbital energy level diagram for BeH<sub>2</sub> molecule.

Or

- (b) What advantages does the VSEPR model of chemical bonding have compared with Lewis formulas?

13. (a) Write short note on symbiosis.

Or

- (b) Give an account of the general characteristics of solvents.

14. (a) Describe the atomic power project in India.

Or

- (b) Write notes on heavy ion reactions.

15. (a) What are inorganic metal clusters? Explain the bonding in dinuclear clusters.

Or

- (b) (i) Define Wade's rule.  
(ii) What are isopoly and heteropoly acids?

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).  
Each answer should not exceed 600 words.

16. (a) Give an account on:  
(i) Anomalous ionization potential  
(ii) Instantaneous dipole – induced dipole interactions.

Or

- (b) (i) Write briefly on the factors affecting electron affinity.  
(ii) Narrate the hydrogen bonding and its types.

17. (a) (i) Write an account of Born-Haber cycle with an appropriate example.  
(ii) What do you understand by apicophilicity?

Or

- (b) (i) List the rule for the linear combination of atomic orbitals method.
- (ii) Explain the stereochemistry of hybrid orbitals.
18. (a) (i) Narrate the classification of protic and aprotic solvents.
- (ii) What do you understand by solvation effects?
- (iii) State HSAB principle.

Or

- (b) Give an account of the following reactions in liquid  $\text{NH}_3$ .
- (i) Ammonation reactions
- (ii) Ammonolytic reactions
- (iii) Metatheses reactions.
19. (a) Define the term nuclear cross section. What are the unit? How is the nuclear cross section for a particular reaction determined?

Or

- (b) (i) Discuss the applications of radioactive isotopes in neutron absorptionmetry.
- (ii) What do you mean by threshold energy?

20. (a) (i) Describe the structure and bonding in boranes.
- (ii) Give the types of catenation with examples.

Or

- (b) (i) Discuss the structure of 12-heteropoly anion,  $[P(Mo_3O_{10})_4]^{3-}$ .
- (ii) Explain the structure phosphazenes.
-

(6 pages)

Reg. No. : .....

**Code No. : 6397**

**Sub. Code : ZCHM 13**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

First Semester

Chemistry – Core

QUANTUM MECHANICS AND SPECTROSCOPY – I

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Schrodinger equation is a \_\_\_\_\_.
  - (a) 1<sup>st</sup> order differential equation
  - (b) Second order differential equation
  - (c) Both (a) and (b)
  - (d) None of these

2. Hamiltonian is given by
  - (a) sum of K.E. and P.E.
  - (b) Difference of K.E. and P.E.
  - (c) Product of K.E. and P.E.
  - (d) Square root of K.E. and P.E.
  
3. In one dimensional problem the energy levels of a bound state system are
  - (a) Discrete
  - (b) Degenerate
  - (c) Non degenerate
  - (d) Discrete and non degenerate
  
4. Who discovered the one-dimensional wave function?
  - (a) Isaac Newton            (b) Robert Boyle
  - (c) Joseph Fourier        (d) Jean d'Alembert
  
5. For what number of zeros, the approximation is poor?
  - (a) 1                            (b) 2
  - (c) 3                            (d) 4



6. Variational parameters are adjusted until the energy of the \_\_\_\_\_ wave function is minimized.
- (a) Atomic                      (b) Molecular  
(c) Ionic                         (d) Trial
7. Which of the following molecule shows rotational spectra?
- (a) N<sub>2</sub>                            (b) H<sub>2</sub>  
(c) CO<sub>2</sub>                         (d) Co
8. Which of the following is called heat radiation?
- (a) Infrared radiation  
(b) Microwave  
(c) Gamma rays  
(d) X-rays
9. Overtones are mainly observed in \_\_\_\_\_.
- (a) Far IR                        (b) Mid IR  
(c) Near IR                      (d) Not in the IR region
10. In Raman spectroscopy, the radiation lies in the \_\_\_\_\_.
- (a) UV Region                 (b) X-ray region  
(c) Visible region              (d) microwave region

PART B — (5 × 5 = 25 marks)

Answer ALL the questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Write a note on Hermitian operator.

Or

- (b) Comment on quantum mechanical treatment of angular momentum.

12. (a) The ground state wave function of a harmonic oscillator is  $\psi = \exp(-\alpha x^2)$  where  $\alpha = \frac{4\pi^2 mE}{h^2}$  and  $-\infty \leq x \leq \infty$ . Find the most probable value of  $x$ .

Or

- (b) Explain the anharmonicity force constant and its significance.

13. (a) Write a note on the approximations used in the HMO method.

Or

- (b) Give an account of Heitler – London treatment.

14. (a) Write briefly on Boltzmann distribution.

Or

(b) Give an account of rotational spectra of symmetric top polyatomic molecules.

15. (a) Discuss the vibrations in linear molecules and symmetric top molecules.

Or

(b) (i) Comment on absorption frequencies of any three functional groups for organic compounds.

(ii) What is meant by Rayleigh scattering?

PART C — (5 × 8 = 40 marks)

Answer ALL the questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Write a note on postulates of quantum mechanics.

Or

(b) Discuss in detail the time-dependent and time-independent Schrodinger wave equations.

17. (a) Explain briefly the quantum mechanical treatment of simple harmonic oscillator.

Or

- (b) (i) Narrate the radial distribution functions.  
(ii) For a particle in a one-dimensional box of length 'L', find the probability in the region  $0 \leq X \leq L/4$  for  $n = 1$ .

18. (a) Discuss briefly the linear variation method.

Or

- (b) Write an account on Pauli exclusion principle and Slater determinant for He atom.

19. (a) Write notes on the following

- (i) Collision broadening  
(ii) Doppler broadening.

Or

- (b) (i) Comment on transition moment integral.  
(ii) What are the characteristics of an electromagnetic radiation?

20. (a) (i) Stokes lines are more intense than anti-Stokes lines. Explain why?  
(ii) State and explain Born – Oppenheimer approximation.

Or

- (b) Describe the theory and principle of vibrational – rotational Raman spectroscopy.

(7 pages)

Reg. No. : .....

**Code No. : 6398**

**Sub. Code : ZCHE 11**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

First Semester

Chemistry

Elective – GREEN CHEMISTRY TECHNIQUES AND  
APPLICATIONS

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer.

1. Green chemistry is also called as \_\_\_\_\_.
  - (a) Life chemistry
  - (b) Environmental chemistry
  - (c) Organic chemistry
  - (d) Sustainable chemistry

2. 'E' Factor is \_\_\_\_\_
- (a) Mass ratio of waste to desired product
  - (b) Ratio of molecular weight of desired product and molecular weights of all substances produced in the stoichiometric equation
  - (c) Percentage of all the materials used in the preparation
  - (d) Total mass used in a process divided by the mass of product
3. "Zeolite" is the broad term used to describe a family of minerals called \_\_\_\_\_
- (a) Tri silicates            (b) Tectosilicates
  - (c) Tetrasilicates        (d) Pentasilicates
4. Greener catalysis means
- (a) Moving away from stoichiometric processes to homogenous and heterogeneous catalytic reactions using organic, organometallic, inorganic and biological catalysts
  - (b) Developing chemicals that are recyclable
  - (c) Design chemical products and processes that work most efficiently
  - (d) Reduced costs associated with waste treatment and disposal

5. An ideal solvent facilitates the \_\_\_\_\_
- (a) Mass transfer      (b) Dissolving property  
(c) Combustion      (d) Titration
6. Which of the following is the greenest solvent?
- (a) Formaldehyde      (b) Benzene  
(c) Ethanol      (d) Water
7. Microwave assisted reaction operates at a frequency of \_\_\_\_\_.
- (a) 3 GHz      (b) 2.45 GHz  
(c) 2 MHz      (d) 3 MHz
8. In microwave Assisted Hofmann Elimination quaternary ammonium salts are heated at
- (a) High temperature and the yield of the Hofmann elimination product is low  
(b) Low temperature and the yield of the Hofmann elimination product is high  
(c) High temperature and the yield of the Hofmann elimination product is high  
(d) Low temperature and the yield of the Hofmann elimination product is low

9. A Solar cell is an electrical device that converts the energy of light directly into electricity by the
- (a) Photovoltaic effect
  - (b) Chemical effect
  - (c) Atmospheric effect
  - (d) Physical effect
10. The main composition of biogas is \_\_\_\_\_
- (a) Nitrogen                      (b) Carbon dioxide
  - (c) Methane                      (d) Hydrogen

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) (i) Explain atom economy.
- (ii) Write a brief notes on waste minimisation.
- Or
- (b) (i) What is reaction mass efficiency?
- (ii) Define Mass intensity.



12. (a) (i) Which catalyst is used in green chemistry?  
(ii) What are the three types of catalyst? Give example for each type.

Or

- (b) Write notes on alternate energy sources to conventional energy sources.

13. (a) (i) What is super cooled water?  
(ii) Write and explain a green reaction done with super cooled water.

Or

- (b) Write notes on tunable and switchable solvent systems

14. (a) Write Photochemical ring closure of dienes and explain mechanism.

Or

- (b) Explain the merits and demerits of microwave techniques.

15. (a) What are the top five sources of renewable energy?

Or

- (b) Discuss the applications and limitations of geothermal Power.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) State the Principles of Green Chemistry.

Or

- (b) Discuss the steps for reduction of non-renewable raw materials usage.

17. (a) Discuss Bio-catalysis.

Or

- (b) Write notes on Phase-transfer catalysis and its advantage.

18. (a) Discuss any Four chemical reactions done with green solvents.

Or

- (b) Discuss the applications of ionic liquids as catalysts and solvents.

19. (a) (i) Write notes on Microwave assisted Hoffman elimination and Heck reactions.
- (ii) Explain Microwave solvent free deacetylation and saponification of ester reactions.

Or

- (b) (i) What do you mean by sonochemistry?
- (ii) Discuss the Principle of sonochemistry.
- (iii) Write notes on ultra sound assisted Simmons-Smith reaction.
20. (a) Explain the Principle, types and applications of solar cells.

Or

- (b) Write note on
- (i) Hydroelectric Power
- (ii) Biomass
- (iii) Wind Power and
- (iv) Geothermal Power
-

(6 pages)

Reg. No. : .....

**Code No. : 6399**

**Sub. Code : ZCHE 12**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

First Semester

Chemistry

Elective – CHEMISTRY OF INDUSTRIAL PRODUCTS  
AND FORMULATION

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Which one of the following essentially consists of oil and a strong drier.
  - (a) Anti corrosive paint
  - (b) aluminum paint
  - (c) bituminous paint
  - (d) asbestos paint

2. Lead is used as a \_\_\_\_\_ in paint
- (a) Drier                      (b) Carrier  
(c) Base                        (d) Pigment
3. An agent used to clean the surface of teeth and thereby decrease tooth decay; mouth odour is
- (a) Abrasive                  (b) Dentifrice  
(c) Dental paste              (d) Dental cone
4. The concentration of plasticizer in nail polish is
- (a) 1%                          (b) 5%  
(c) 15%                        (d) 20%
5. Ozone (O<sub>3</sub>) is a powerful oxidizing agent for \_\_\_\_\_ material
- (a) Lignocellulosic        (b) Lignin  
(c) Outskirts of lamella (d) Middle lamella
6. In which of the following process, the pulp is separated from large shives, knots, and etc.
- (a) Shredding                (b) Cutting  
(c) Picking                    (d) Screening

7. The unknown, homogenization renders milk much less susceptible to \_\_\_\_\_ induced oxidized flavor.
- (a) Copper
  - (b) Oxidizable lipide
  - (c) Rancidity and Rancid
  - (d) Phospholipids
8. The primary function of vitamins is to facilitate transfer energy and to regulate \_\_\_\_\_ in the body.
- (a) Metabolism
  - (b) Oxygen carrier
  - (c) Energy conversion
  - (d) All synthesis
9. Silk, all natural cellulose and protein based fibers are obtained in short \_\_\_\_\_ lengths and these are called \_\_\_\_\_
- (a) Staple fibers
  - (b) Filament
  - (c) Bonded
  - (d) Coarse
10. Cotton is known as our \_\_\_\_\_ crop.
- (a) Finished
  - (b) Bleached
  - (c) Cash
  - (d) Calendered

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).  
Each answer should not exceed 250 words.

11. (a) Write a short note on pigments

Or

(b) Describe the term epoxy coatings.

12. (a) Define cosmetics and its classification.

Or

(b) Write a note on face powder.

13. (a) Establish the term - mechanical pulping.

Or

(b) Correlate the chemical properties of paper.

14. (a) Define milk and write note on physicochemical properties of milk.

Or

(b) Describe the advantages of flavored milk.

15. (a) Explain the characteristics of textile fibres in detail.

Or

(b) Write a short note on - UV protection.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

Each answer should not exceed 600 words.

16. (a) Briefly describe the methods used for the preparation of white pigments and its applications.

Or

- (b) Explain drying mechanism and epoxy coatings.

17. (a) Explain the sources and its classifications of perfumes.

Or

- (b) Distinguish between the moisturizing soap and medicated soap.

18. (a) Explain the woody and non woody fibres used in paper industry.

Or

- (b) Explain the assessment of paper and its physical, optical properties.



19. (a) Describe the following terms: milk product, composition of butter and ghee.

Or

- (b) Explain special milk and the advantages of sterilized milk and toned milk

20. (a) Write down the classifications of textile fibers and their Practical utility.

Or

- (b) Define Nylon-6 & Nylon-6. Explain it using proper example.
-

(6 pages)

Reg. No. : .....

**Code No. : 6400**

**Sub. Code : ZCHE 13**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

First Semester

Chemistry – Elective

**FORENSIC CHEMISTRY**

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Dying declaration is be preferably recorded by  
(a) Doctor                      (b) Police  
(c) Magistrate                (d) Jury Member
2. In case of carbon monoxide poisoning, the preservative is recommended \_\_\_\_\_ for blood sample.  
(a) Sodium chloride        (b) Sodium Fluoride  
(c) Sodium Carbonate      (d) No preservative

3. Which of the following is used to measured (BAC)
  - (a) Weight /Volume percent
  - (b) Volume/Volume percent
  - (c) Weight/Weight percent
  - (d) All the above
4. Which of the following disease affects handwriting?
  - (a) Chronic leukaemia
  - (b) Chronic Malaria
  - (c) Parkinson
  - (d) Thalassemia
5. Cannabis Sativa L. referred as
  - (a) Heroin
  - (b) Marijuana
  - (c) Cellulose
  - (d) Cathinone's
6. Which is the technique used to analyze the ink
  - (a) Thin layer chromatography
  - (b) HPLC
  - (c) Paper chromatography
  - (d) Gel permeation chromatography

7. Variable number of tandem repeats serves as a marker key for identification in
  - (a) DNA Fingerprinting
  - (b) PCR amplification
  - (c) Filter Hybridization
  - (d) Autoradiography
8. Which one caused blindness
  - (a) Ethanol
  - (b) Methanol
  - (c) Propanol
  - (d) Glycol
9. Preservation of footprint on snow can be done by
  - (a) Plaster of Paris Cast
  - (b) Sulphur Casting
  - (c) Tracing
  - (d) Wax Casting
10. Hollow cathode lamp (HCL) is used in the following:
  - (a) Atomic Absorption Spectrometer
  - (b) Atomic Emission Spectrometer
  - (c) Infra-Red Spectrometer
  - (d) X-ray Fluorescence Spectrometer

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).  
Each answer should not exceed 250 words.

11. (a) Explain the Forensic Science and role of the Forensic laboratory in detail.

Or

- (b) Write a note on concepts of biometric authentication.

12. (a) Describe the principles of fingerprinting.

Or

- (b) Write a note on Forensic Serology.

13. (a) Explain the term - Forensic analysis?

Or

- (b) Describe the Physical analysis of Ink and Paper.

14. (a) Summarize the Forensic Toxicology.

Or

- (b) Explain the Postmortem Toxicology in detail.

15. (a) Describe the uses of Computer in Forensic Science.

Or

- (b) Summarize the Computer related crime.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

Each answer should not exceed 600 words.

16. (a) Write about the overview of fingerprint technology.

Or

- (b) Describe the term global poisoning system and summarize its application

17. (a) Write a note on Saliva testing methods, techniques and used their applications.

Or

- (b) Briefly explain small particle reagent analysis and their applications.

18. (a) Compare gamma hydroxyl butyric acid and gamma butyro lactone.

Or

- (b) Explain the following forensic analysis methods in detail.

19. (a) Classify the types of forensic toxicology.

Or

(b) Illustrate the DNA Fingerprinting.

20. (a) Discuss the Cyber Technology.

Or

(b) Describe the human aspects of computer –  
Related Crime.

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(8 pages)

Reg. No. : .....

Code No. : 6401

Sub. Code : ZCHM 21

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Second Semester

Chemistry – Core

STEREOCHEMISTRY, ORGANIC REAGENTS AND  
PHOTOCHEMISTRY.

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer.

1. Compounds that are mirror images of each other are called \_\_\_\_\_.
  - (a) stereoisomers
  - (b) diastereomers
  - (c) enantiomers
  - (d) conformers



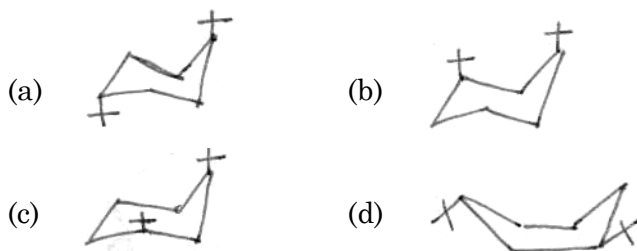
2. Which of the following is an example of regio-selective reaction?

- (a) Addition of HI to propylene
- (b) Debromination of mesodibromobutane
- (c) 2-Bromo octane with sodium hydroxide
- (d) Debromination of 2,3-dibromobutane

3. The diequatorial form of trans-1,2-dimethyl cyclohexane has \_\_\_\_\_ gauche-butane interaction.

- (a) 1
- (b) 2
- (c) 3
- (d) 4

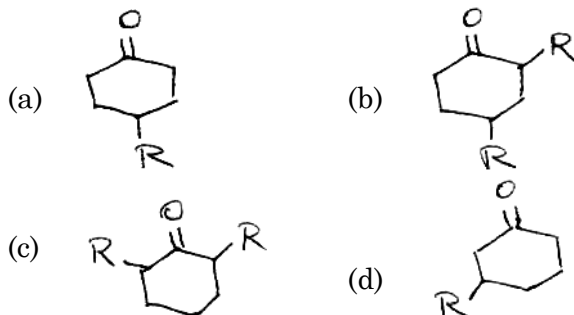
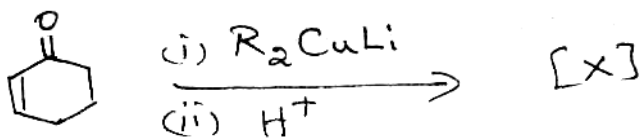
4. Which one of the following conformations is the highly stable?



5. Oxidation of acetaldehyde with selenium dioxide produces \_\_\_\_\_.

- (a) Ethanoic acid
- (b) Oxalic acid
- (c) Methanoic acid
- (d) Glyoxal

6. In the reaction sequence



7. Which type of electronic transition can be seen in saturated aldehydes and ketones?

- (a)  $n \rightarrow \pi^*$  and  $\pi \rightarrow \pi^*$
- (b)  $n \rightarrow \sigma^*$
- (c) only  $\pi \rightarrow \pi^*$
- (d)  $\sigma - \sigma^*$

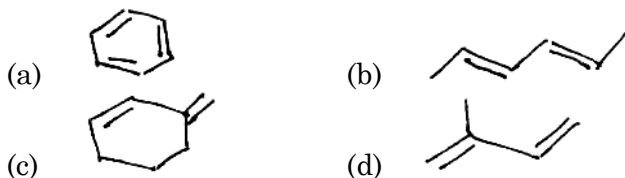
8. Photochemical reactions involving fission of  $\alpha$ -carbon and carboxylic carbon followed by elimination is known as \_\_\_\_\_.

- (a) Norrish type-II process
- (b) Norrish type-I process
- (c) Norrish type-III process
- (d) None of these

9. On heating Cis-3,4-dimethylcyclobutene is converted back to \_\_\_\_\_.

- (a) (Z, Z)-penta-2,4-diene
- (b) (E, Z)-Hexa-2,4-diene
- (c) (Z, Z)-Hexa-2,4-diene
- (d) (E, E)-Hexa-2,4-diene

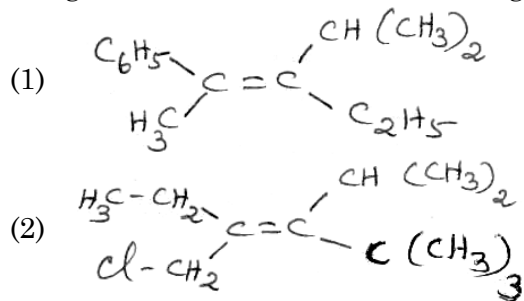
10. Which of the following dienes cannot undergo Diels-Alder reactions?



PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) (i) What is Prelog's rule? Explain its use.  
 (ii) Assign E or Z notation for the following :



Or

- (b) Explain asymmetric synthesis.

12. (a) Discuss the conformations and stability of decalins.

Or

- (b) (i) Point out the difference between configuration and conformation of a molecule.
- (ii) Predict the most stable chair conformation of isomeric cis and trans 1,2-dimethylcyclohexanes.
13. (a) Indicate the applications of the following reagents in organic synthesis
- (i) Luche reagent
- (ii) Fetizon's reagent.

Or

- (b) Discuss the uses of the following reagents :
- (i) 1,3-Dithane
- (ii) Vaska's catalyst.
14. (a) (i) Write a brief note on Photosensitization.
- (ii) Outline the mechanism of Photoreduction.

Or

- (b) Give an account of cis-trans isomerization of olefins brought about photochemically. How does it differ from the thermal isomerization?

15. (a) How does the stereochemistry of the products formed in electrocyclic reactions are affected HOMO? Explain.

Or

- (b) Construct an orbital correlation diagram for conrotatory interconversions of 1,3-butadiene and cyclobutene.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) (i) With suitable examples explain enantiotopic and diastereotopic hydrogens.
- (ii) Discuss the stereochemistry of a compound having two dissimilar asymmetric carbon centres.

Or

- (b) (i) What are stereospecific and stereoselective reactions? Explain with suitable examples.
- (ii) Define a prochiral centre and give an example of a molecule that contain this centre.

17. (a) (i) Draw the conformation of cis-syn-cis perhydrophenanthrene.
- (ii) Give an account of conformations and reactivity of cyclohexanones.

Or

- (b) (i) Draw the conformations of cis and trans 4-t-butylcyclohexane tosylates. In a solvolysis reaction which one will solvolyze faster. Rationalize your answer.
- (ii) Discuss the reactions of the two different conformers of cis-2-aminocyclohexanol with  $\text{HNO}_2$ .
18. (a) Discuss any five synthetic uses of LDA.

Or

- (b) Give the synthetic applications of the following reagents :
- (i) DCC
- (ii) PCC
- (iii) DMDO
- (iv) Von Rudloff reagent.

19. (a) (i) Distinguish between :
- (1) Singlet and triplet excited states
  - (2) Fluorescence and Phosphorescence.
- (ii) Describe Norrish type II reactions with examples.

Or

- (b) Write briefly on :
- (i) Paterno-Buchi reaction
  - (ii) Di- $\pi$  methane rearrangement.
20. (a) (i) Construct the correlation diagram for [2+2] cycloaddition and state the conditions under which the addition occurs.
- (ii) What is aza-cope rearrangement?

Or

- (b) (i) Give a typical example of Cope rearrangement. Explain on the basis of frontier molecular orbital theory how it is thermally allowed.
- (ii) Explain electrocyclic ring closure reaction of allylic carbanion.

(7 pages)

Reg. No. : .....

**Code No. : 6402**

**Sub. Code : ZCHM 22**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022

Second Semester

Chemistry – Core

COORDINATION COMPOUNDS AND SOLID STATE  
CHEMISTRY

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Crystal field theory focuses on the nonbonding electrons on the \_\_\_\_\_ in coordination complexes not on the \_\_\_\_\_
  - (a) Central metal ion, metal-ligand bonds
  - (b) Metal-ligand bonds, central metal ion
  - (c) Ligand, Central metal
  - (d) None of these above



2. Crystal field theory assumes that the attraction between the \_\_\_\_\_ and in a complex is essentially electrostatic
- (a) Metal ion, metal ion
  - (b) Ligands, ligands
  - (c) Metal ion, ligands
  - (d) None of these above
3. For charged ligands \_\_\_\_\_ the charge and \_\_\_\_\_ the size the more stable in the complex formed
- (a) Lower, larger      (b) higher, larger
  - (c) Lower, smaller      (d) higher, larger
4. Chelate complexes are \_\_\_\_\_ stable than the corresponding complexes containing indentate ligands.
- (a) more      (b) less
  - (c) least      (d) none of these above
5. For a diamagnetic material, which of the following statement is correct?
- (a) Magnetic susceptibility  $< 0$
  - (b) Magnetic susceptibility  $> 0$
  - (c) Magnetic susceptibility = 1
  - (d) Magnetic susceptibility = 0

6. With an increase in temperature, magnetic susceptibility of a ferromagnetic material \_\_\_\_\_
- (a) First increases and then decreases
  - (b) Remains constant
  - (c) Decreases
  - (d) Increases
7. Frenkel defect is not found in the halides of alkali metals because alkali metals have
- (a) High electropositivity
  - (b) High ionic radii
  - (c) Ability to occupy interstitial sites
  - (d) High reactivity
8. A compound that can show both, Frenkel as well as schottky defects is \_\_\_\_\_
- (a)  $ZnS$
  - (b)  $NaCl$
  - (c)  $AgBr$
  - (d)  $AgI$
9. A semiconductor has \_\_\_\_\_ temperature coefficient of resistance
- (a) Zero
  - (b) Positive
  - (c) Negative
  - (d) None of the above

10. What is the property of insulating materials?
- (a) Prevents the unwanted flow of current
  - (b) Decreases the unwanted flow of current
  - (c) Increases the unwanted flow of current
  - (d) Allow the unwanted flow of current

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Discuss the various factors influencing the magnitude of crystal field splitting.

Or

- (b) Narrate the application of molecular orbital theory to explain spectrochemical series.

12. (a) Define, 'stepwise stability constant and overall stability constant'. How are they related?

Or

- (b) Discuss the  $\pi$ -bonding theory of Trans effect.

13. (a) Write briefly on orbital quenching.

Or

- (b) Narrate the types of magnetic behaviours.

14. (a) Give the conditions for the formation of Frenkel and Schottky defects.

Or

- (b) (i) Write briefly on limiting radius ratio.  
(ii) Define packing efficiency of a molecule.

15. (a) Write a note on free electron theory.

Or

- (b) Write an explanatory note in Meissener effect.

PART C — ( $5 \times 8 = 40$  marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) (i) Discuss the effect of Jahn Teller distortion in electronic spectra.  
(ii) What are the limitations of crystal field theory?

Or

- (b) Explain the crystal field stabilization energy in octahedral and tetrahedral complexes.

17. (a) (i) List out the factors which affect the stability of a metal complex.  
(ii) Illustrate a dissociative substitution reaction.

Or

- (b) (i) Discuss the spectroscopic method of determination of stability constant of a metal complex.  
(ii) What are complementary and non complementary electron transfer reactions?
18. (a) Describe the Gory method of determination of the magnetic susceptibility of a substance.

Or

- (b) Explain the magnetic properties of lanthanides and actinides.
19. (a) (i) Explain the powder method of determining crystal structure.  
(ii) Give any four example of compounds which have rutile structure.

Or

- (b) Explain briefly the structures of the following crystals  
(i) Zinc blende  
(ii) Fluorite  
(iii) Cscl

20. (a) (i) What is Hall effect? How is it used to explain conductivity?
- (ii) What is the difference between insulator and semiconductor?

Or

- (b) (i) What is photovoltaic effect? Explain with suitable examples.
- (ii) What are the two types of semiconductors.
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(7 pages)

Reg. No. : .....

**Code No. : 6403**

**Sub. Code : ZCHM 23**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Second Semester

Chemistry - Core

**ELECTRO CHEMISTRY AND SPECTROSCOPY – II**

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Medium under the influence of applied potential is known as
  - (a) Electrophoresis
  - (b) Electro-osmosis
  - (c) Osmosis
  - (d) None of these





6. Vibronic coupling in a molecule involves the interaction between \_\_\_\_\_ and \_\_\_\_\_
- (a) Electronic, molecular motion
  - (b) Electronic, nuclear vibrational motion
  - (c) Molecular, nuclear vibrational motion
  - (d) Electronic, atomic motion
7. Which of the following will not show electron spin resonance?
- (a) Free radicals
  - (b) Transition metals
  - (c) Paramagnetic materials
  - (d) Diamagnetic materials
8. Rotation of electrons about the protons generates a secondary magnetic field which opposes the applied magnetic field. The proton is said to be
- (a) Shifted
  - (b) Deshielded
  - (c) H-Bonded
  - (d) Shielded
9. NQR spectroscopy is referred to as
- (a) High field NMR
  - (b) Low field NMR
  - (c) Zero field NMR
  - (d) None of the above



14. (a) Discuss the theory of FT – NMR spectroscopy.

Or

(b) How ESR spectra is represented? Explain why? Give an account of line width in ESR.

15. (a) Explain the basic principle of Massbauer spectroscopy.

Or

(b) Write a brief account of quadrupole splitting.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

Each answer should not exceed 600 words.

16. (a) (i) Give Debye – Huckel Onsager equation.  
How is it verified?

(ii) What do you understand by the term mean ion activity?

Or

(b) Write an account on:

(i) Zeta potential

(ii) Electrophoresis

17. (a) (i) Discuss the application of EMF measurements for the determination of (1) solubility product (2) Equilibrium constant.
- (ii) Define liquid junction potential. How will you eliminate the same?

Or

- (b) Derive Butler-Volmer equation for an electrode process involving one electron transfer and deduce Tafel equation.
18. (a) Discuss the breakdown of Born-oppenheimer approximation or interaction of rotations and vibrations.

Or

- (b) Explain the principle and technique of ultra violet photoelectron spectroscopy.
19. (a) (i) Discuss the fine structure in EPR or zero field splitting.
- (ii) "Chemical shift is field dependent while coupling constant is not" Explain why?

Or

- (b) Define chemical shift. How it is expressed? What are the factors affecting it?

20. (a) (i) Describe the effect of magnetic field on the NQR spectra.

(ii) What is doppler shift?

Or

(b) (i) Write a note on molecular ion peak.

(ii) For  $S_nX_4$  ( $X = F, Cl, Br, I$ ) how isomer shift varies with electro negativity of substituents?

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(6 pages)

Reg. No. : .....

**Code No. : 6404**

**Sub. Code : ZCHE 21**

M.Sc.(CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022

Second Semester

Chemistry

Elective– NANO SCIENCE AND NANOTECHNOLOGY

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions

Choose the correct answer :

1. Which property of nanoparticles provides a driving force the diffusion?
  - (a) Optical Properties
  - (b) High surface area to volume ratio
  - (c) Sintering
  - (d) There is no such property

2. Quantum dots can be used in \_\_\_\_\_.  
(a) Crystallography      (b) Optoelectronics  
(c) Mechanics              (d) Quantum physics
3. What are the approaches used in making nanosystems?  
(a) Top-down              (b) Bottom-up  
(c) Neither a nor b      (d) Both (a) and (b)
4. The art and science of etching, writing or printing at the microscopic level in the order of nanometer is \_\_\_\_\_.  
(a) NEMS                  (b) Nanofabrication  
(c) Nanopaltcinins      (d) Nanolithography
5. Expand PNCS.  
(a) Poly Nanocomposites  
(b) Polymer Nanocomposites  
(c) Polymer Nanocompounds  
(d) Polymer Nylon compounds
6. What are the advantages of nano-composite packages?  
(a) Lighter and biodegradable  
(b) Enhanced thermal stability, conductivity and mechanical strength  
(c) Gas barrier properties  
(d) All of the above

7. A water-cooled surface is used in the process to collect \_\_\_\_\_.
- (a) Nanoparticles      (b) Nanotubes  
(c) Nanospheres      (d) Nanosheets
8. Fullerenes are soluble in \_\_\_\_\_.
- (a) Water      (b) Aromatics  
(c) Carbon disulfide      (d) Both (b) and (c)
9. The processing of separation, consolidation and deformation of materials by one atom or one molecule is called as \_\_\_\_\_.
- (a) biotechnology      (b) physics  
(c) nanobiotechnology      (d) chemistry
10. Branched polymers are \_\_\_\_\_.
- (a) SPIONS  
(b) Liposomes  
(c) Dendrimers  
(d) Block copolymers in the next unmanned mission to Mars.



PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b)  
Each answer should not exceed 250 words

11. (a) Write the definitions of nanoparticles.

Or

(b) Write a comprehensive note on Nanowire.

12. (a) Give the synthesis of nanoparticles by physical vapour deposition (PVD) method.

Or

(b) Explain the bottom-up and top-down approaches in nanoparticle synthesis.

13. (a) Give the classification of Nanocomposites.

Or

(b) Write a comprehensive note on polymer-based nanocomposites.

14. (a) Write note on the reduction of graphene oxide.

Or

(b) Write a brief note on Graphene nanoribbon (GNRs).

15. (a) What are dendrimers? Mention its biomedical applications.

Or

- (b) Substantiate nanomedicine in diagnosis of diseases.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)  
Each answer should not exceed 600 words

16. (a) Narrate the size of building blocks of nanostructures.

Or

- (b) Explain the surface ratio in nano-materials.

17. (a) Give the synthesize of nanomaterials using Laser Ablation and Chemical Vapour Deposition Methods.

Or

- (b) Write note on the synthesis of nanoparticles by biological methods.

18. (a) Give a brief account on Nanocomposites.

Or

- (b) Discuss the Polymer based Nanocomposites.

19. (a) Give a brief account on Functionalized graphene polymer nanocomposites (FPNs).

Or

(b) Give a brief account on fullerenes.

20. (a) Highlight the recent developments in modern cancer chemotherapy?

Or

(b) Discuss the materials used in tissue engineering.

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(6 pages)

Reg. No. : .....

Code No. : 6405

Sub. Code : ZCHE 22

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Second Semester

Chemistry

Elective – MEDICINAL CHEMISTRY

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer.

1. What the body does to a drug is called \_\_\_\_\_.
  - (a) pharmacodynamics
  - (b) pharmacotherapeutics
  - (c) pharmacognosy
  - (d) pharmacokinetics

2. What are soft drugs?
- (a) Drugs given to babies
  - (b) Chemical drugs which are already found in the body
  - (c) Nutrients which kill the gut harmful microbes
  - (d) Anything that is not nutrients and enters the body through different routes
3. The first step in the drug discovery process is \_\_\_\_\_.
- (a) Lead modification
  - (b) Lead optimization
  - (c) Lead validation
  - (d) Lead Identification
4. Meperidine was derived from which of the following Lead?
- (a) Cocaine
  - (b) Morphine
  - (c) Coumarin
  - (d) Quinine
5. Penicillin has \_\_\_\_\_ thiazolidine structure.
- (a)  $\alpha$ -lactam
  - (b)  $\beta$ -lactam
  - (c)  $\delta$ -lactam
  - (d)  $\gamma$ -lactam

6. Benzylpenicillin is the chemical name for which of the following penicillin?
- (a) Penicillin V            (b) Penicillin F  
(c) Penicillin G            (d) Phenethicilin
7. Which of the following drugs is not classified in the criteria based on the pharmacological effect?
- (a) Antihistamines        (b) Antiseptics  
(c) Analgesics              (d) Antipyretics
8. The drug used to lower body temperature are called \_\_\_\_\_.
- (a) Antipyretics            (b) Antiseptic  
(c) Analgesics              (d) Disinfectant
9. The Drug for the Treatment of Hypertension in pregnant woman is \_\_\_\_\_.
- (a) Methyldopa            (b) Captopril  
(c) Verapamil              (d) All the above
10. The following is true of cyclophosphamide except:
- (a) It is highly reactive and a vesicant on contact  
(b) It is a prodrug  
(c) It has marked immunosuppressant property  
(d) It frequently causes alopecia and cystitis

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Write the general principle of drug action.

Or

- (b) How will you classify the drug receptor interactions?

12. (a) Narrate the structure and ligand-based drug design.

Or

- (b) Explain the Hansch equation.

13. (a) How will you distinct between antiseptics and disinfectants?

Or

- (b) Write the therapeutic uses and adverse effects of Penicillin.

14. (a) Write the synthesis of antimalarial drug aminoquinolines.

Or

- (b) Write the synthesis and therapeutic uses of paracetamol.

15. (a) Describe about the cardiovascular drugs.

Or

(b) Give the synthesis of methyldopa.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Discuss the strategies for the design of prodrugs. Mention the applications of prodrug.

Or

(b) Discuss the elementary aspects of ADME.

17. (a) Brief in detail about the Quantitative Structure Activity Relationship (QSAR).

Or

(b) Narrate the elementary treatment of drug receptor interactions.

18. (a) Enumerate the structural features and mode of action of  $\beta$ -lactum antibiotics.

Or

(b) Discuss the structural features and mode of action of Cephalosporin and their synthetic analogues  $\beta$ -lactum.



19. (a) Write a note on antipyretic analgesics. Write the synthesis of paracetamol.

Or

- (b) Brief in detail about hypoglycaemic agents.

20. (a) Highlight the recent developments in modern cancer chemotherapy.

Or

- (b) Give the synthesis and therapeutic uses of Cisplatin and Carboplatin.
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(6 pages)

Reg. No. : .....

Code No. : 6406

Sub. Code : ZCHE 23

M.Sc.(CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Second Semester

Chemistry

Elective – INDUSTRIAL PROCESSES AND  
CATALYSIS

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. In which unit operation, gases are released or absorbed in the effluent?  
(a) Gas transfer      (b) Ion transfer  
(c) Solute stabilization      (d) Solid transfer
2. In which process, excess lime is converted into bicarbonate?  
(a) Chlorination      (b) Liming  
(c) Re-carbonation      (d) Increase efficiency

3. What is the use of cross flow in plate and frame module?
  - (a) Reduces fouling
  - (b) Reduces loss
  - (c) Reduces efficiency
  - (d) Increase efficiency
4. Which membrane module represents in spiral heat exchange?
  - (a) Plate and frame module
  - (b) Spiral wound module
  - (c) Hollow fibre module
  - (d) No module exists
5. How does a catalyst increase the rate of a reaction?
  - (a) By forming an intermediate complex
  - (b) By increasing activation energy
  - (c) By lowering the activation energy
  - (d) By changing equilibrium constant

6. Efficiency of the catalyst depends on its
- (a) Molecular weight
  - (b) Number of free valencies
  - (c) Physical state
  - (d) Amount of reactant used
7. Refining is \_\_\_\_\_
- (a) Extracting petroleum gas
  - (b) Separation of various fractions of petroleum
  - (c) Heating of Coal
  - (d) Sedimentation of fossil fuel
8. Which gas is obtained during the processing of coal?
- (a) Coal gas                      (b) Water gas
  - (c) Oil gas                        (d) Producer gas

9. Which of the following does not contribute to pollution in aquatic bodies?
- (a) Heavy metals      (b) Ozone  
(c) Microplastics      (d) Pesticides
10. Shortly after midnight in 1948, a reaction caused poisonous methyl isocyanate gas to leak from a factory in this city, \_\_\_\_\_ causing 3,700 deaths?
- (a) Bhopal              (b) Hinkley  
(c) Calculate            (d) Siberia

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Write the concepts of unit operation and unit process.

Or

- (b) What are the advantages and disadvantages of the batch process versus the continuous process

12. (a) Write the principle of reverse osmosis.

Or

- (b) Define the terms Flux, Fouling, Scaling and Slit Density Index.

13. (a) Write the general features and industrial application of catalysis.

Or

- (b) Describe the homogenous catalysis and its limitations.

14. (a) Describe refining process of gasoline.

Or

- (b) Describe the zeolites as catalysts of environmental Industries.

15. (a) Give an overview on fundamentals of environmental Chemistry.

Or

- (b) Narrate the various environmental segments.

PART C — (5 × 8 = 40 marks)

Answer ALL questions choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Discuss the liquid-liquid and solid liquid extractions.

Or

- (b) Discuss the Crystallization process.

17. (a) Discuss the Pretreatment of water.

Or

(b) Explain zeolite process for softening the hard water.

18. (a) Discuss the Chemisorption process

Or

(b) Discuss the advantages and operational modes of heterogeneous catalyst in industry.

19. (a) Give a brief account on petroleum refining.

Or

(b) Discuss the shape selectivity of zeolite as catalyst .

20. (a) Discuss the effects of pollutants in the environment.

Or

(b) Write the eutrophication concept of BO, BOD, COD and sedimentations.

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(7 pages)

Reg. No. : .....

**Code No. : 6407**

**Sub. Code : ZCHM 31**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Third Semester

Chemistry – Core

**ORGANIC SPECTROSCOPY AND  
REARRANGEMENTS**

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Which of the following statements about infrared spectroscopy is correct?
  - (a) When the frequency of infrared light matches the frequency of bond vibration in a molecule, a peak appears on the spectrum
  - (b) Infrared spectroscopy can be used to determine the size and shape of a compound's carbon skeleton
  - (c) An IR spectrometer illuminates a compound with infrared light and records the positions where the light is blocked by the compound. This results in the peaks of the spectrum
  - (d) The fingerprint region of the spectrum can be used to identify functional groups



2. In an infrared (IR) spectrum, which of the following functional groups has the highest frequency?
- (a) Ketone                      (b) Aldehyde  
(c) Ester                         (d) Alcohol
3. The proton NMR spectrum of  $\text{CH}_3\text{OCHClCH}_2\text{Cl}$  will exhibit \_\_\_\_\_
- (a) A three proton doublet. One proton singlet and a two proton doublet  
(b) A three proton singlet. One proton singlet and a two proton doublet  
(c) A three proton singlet. One proton triplet and a two proton doublet  
(d) A three proton triplet. One proton triplet and a two proton triplet
4. The distance between the centers of the peaks of doublet is called as?
- (a) Coupling constant  
(b) Spin constant  
(c) Spin-spin coupling  
(d) Chemical shift
5. In which state of matter mass spectroscopy is being performed?
- (a) solid                         (b) liquid  
(c) gaseous                      (d) plasma

6. What are the main criteria on which mass spectrometer is reliable on?
- (a) Composition in sample
  - (b) Relative mass of atoms
  - (c) Concentration of elements in the sample
  - (d) Properties of sample
7. The region of electromagnetic spectrum for nuclear magnetic resonance is
- (a) Microwave                      (b) UV-rays
  - (c) Infrared                        (d) Radio frequency
8. The first two-dimensional experiment, COSY, was proposed by \_\_\_\_\_.
- (a) Jean Jeener
  - (b) Madam Curie
  - (c) Newton
  - (d) Christy Catherene Mary
9. Which types of isomers are formed in rearrangement reactions?
- (a) Structural isomers
  - (b) Geometrical isomers
  - (c) Optical isomer
  - (d) Conformational isomers

10. Which was the first molecular rearrangement identified as such by early chemists?
- (a) Wolff's rearrangement
  - (b) Pinacol rearrangement
  - (c) Favorskii rearrangement
  - (d) Hofmann rearrangement

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Explain the various electronic transitions involved in uv-visible absorption spectroscopy.

Or

- (b) Explain the role of Fermi Resonance in infrared spectroscopy.

12. (a) Explain the principle of NMR spectroscopy.

Or

- (b) Explain spin-spin coupling constant

13. (a) Explain the principle of mass spectroscopy.

Or

- (b) Explain :
- (i) Molecular ion peak
  - (ii) Meta stable peak in MS

14. (a) Explain  $^1\text{H}$ - $^{13}\text{C}$  COSY with one example.

Or

- (b) What is the difference between 1D and 2D NMR?

15. (a) Explain memory effect in molecular rearrangement with one example.

Or

- (b) What is Pinacol-Pinacolone rearrangement? Explain its mechanism.

PART C — ( $5 \times 8 = 40$  marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Compare ORD and CD.

Or

- (b) State and explain how Woodward-Fieser Rules are used to calculate maximum absorption values of  $\alpha,\beta$ -unsaturated ketones in uv-visible absorption spectroscopy.

17. (a) Explain spin decoupling with example.  
Or  
(b) Discuss  $^{13}\text{C}$  NMR spectra of carbonyl compounds and olefinic compounds.
18. (a) Elucidate Fragmentation pattern of  
(i) alkanes  
(ii) aldehyde  
(iii) ketones  
(iv) acids in MS  
Or  
(b) What is the principle behind the MALDI-TOF MS?
19. (a) A compound with molecular weight 120 gave a negative iodoform test. It absorbs at  $292\text{ m}\mu$ ,  $\epsilon_{\text{max}} 16$  in the ultraviolet spectrum. In its infra-red spectrum, the values bands are (i)  $3042\text{ (m)}$ ,  $2941\text{ (w)}$ ,  $2862\text{ (w)}$ ,  $1722\text{ (s)}$ ,  $1605$ ,  $1575\text{ (m)}$  and  $1462\text{ cm}^{-1}\text{ (m)}$ .

In the NMR spectrum, three signals are present (i) multiplet,  $2.73\tau$  (26.5 squares), (ii) doublet  $7.2\tau$  (10.3 squares) and  $0.22\tau$  (5.2 squares). The mass spectrum shows  $\text{M}^+$  peak at  $\frac{m}{I}120$  and base peak at  $\frac{m}{z} 91$ . Give the structure of the compound.

Or

(b) An organic compound with molecular formula  $C_8H_7Br$  yields a primary alcohol on hydroboration. The spectral data of the compound is given below.

(i) UV:  $\lambda_{\max} 282 \text{ m}\mu$ ,  $\epsilon_{\max} 450$ .

(ii) IR: 3033 (m), 1646 (m), 1602 (m), 1562 (v), 820 (s) and  $710 \text{ cm}^{-1}$  (m).

(iii) NMR : 2.62-2.74  $\tau$  (asymmetrical pattern, 18.9 squares), 4.30  $\tau$  (double doublet, 4.7 squares), 3.30  $\tau$  (double doublet, 4.9 squares) and 4.86  $\tau$  (double doublet, 5.0 squares).

Determine the structure of the compound.

20. (a) What is Dakin rearrangement? Explain its mechanism.

Or

(b) What is Neber rearrangement? Explain its mechanism.

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(7 pages)

Reg. No. : .....

Code No. : 6408

Sub. Code : ZCHM 32

M.Sc.(CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Third Semester

Chemistry – Core

SPECTRAL METHODS – I ORGANO METALLIC AND  
ANALYTICAL METHODS

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

- The energy of He(I) is \_\_\_\_\_  
(a) 21.21 eV                      (b) 21.21 MeV  
(c) 40.2 eV                        (d) 1457 eV
- ESCA gives sufficient chemical information up to a depth about \_\_\_\_\_Armstrong in metals.  
(a) 5-20                              (b) 15-40  
(c) 40-100                          (d) 100-200

3. Which of the following complex has a highest oxidation state of metal?
- (a)  $(\eta^6 - C_6H_6)_2Cr$
- (b)  $Mn(CO)_5Cl$
- (c)  $Na_2[Fe(CO)_4]$
- (d)  $K[Mn(CO)_5]$
4. Which of the following is the neutral complex which follows the 18- electron rule?
- (a)  $(\eta^5 - C_5H_5)Fe(CO)_2$
- (b)  $(\mu^5 - C_5H_5)_2MO(CO)_3$
- (c)  $(\eta^5 - C_5H_5)_2CO$
- (d)  $(\eta^5 - C_5H_5)_2Re(\eta^6 - C_6H_6)$
5. Which metal centre does not obey the 18-electron rule?
- (a) Fe in  $Fe(\eta^5 - C_5H_4COMe)_2$
- (b) CO in  $CO_2(CO)_8$
- (c) Ru in  $[Ru(\eta^6 - C_6Me_6)_2]^{2+}$
- (d) V in  $V(CO)_6$



6. Which statement about ferrocene is incorrect?
- (a)  $I_2$  oxidizes ferrocene to give a diamagnetic cation
  - (b) The ligands in ferrocene undergo electrophilic substitution with  $RCOCl$  in the presence of a Lewis acid
  - (c) The Fe centre in ferrocene can be protonated by treatment with concentrated  $H_2SO_4$
  - (d) In the gas phase, the  $C_5H_5$  rings in ferrocene are eclipsed
7. What is meant by hydroformylation reaction?
- (a) Reaction of olefins
  - (b) Reaction of Azos
  - (c) Reaction of aromatics
  - (d) All of the mentioned
8. In which process hydroformylation of olefin to an aldehyde occurs?
- (a) Azo process
  - (b) Alkyl process
  - (c) Oxo process
  - (d) None of the mentioned

9. In thermogravimetric analysis, the result obtained appear as a \_\_\_\_\_
- (a) Continuous chart
  - (b) Continuous parabola
  - (c) Continuous circular positions
  - (d) Discontinuous chart
10. The purpose of secondary filter in fluorescence spectroscopy is
- (a) Allows only excitation radiation
  - (b) Allows only emission radiation
  - (c) Allows both excitation and emission radiations
  - (d) Allows transmitted radiation

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).  
Each answer should not exceed 250 words.

11. (a) Write a note on absolute configuration of chelate complexes from ORD.

Or

- (b) Explain the effect of solvent polarity in CT spectra.

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[P.T.O.]

12. (a) Write briefly about PE spectra of oxygen molecule.

Or

- (b) Write a note on types of PES.

13. (a) Write briefly about synthesis of metal complexes with allyl systems.

Or

- (b) Write a note on synthesis and reactions of ferrocene.

14. (a) Write briefly about Cluster compounds in catalysis.

Or

- (b) Write briefly about water gas shift reactions.

15. (a) Write the principles of TGA.

Or

- (b) Write the steps involved in emission spectroscopy based on plasma sources.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)

Each answer should not exceed 600 words.

16. (a) Write a note on Hund's rules and selection rules.

Or

- (b) Discuss the construction of Orgel diagram of octahedral  $d^2$ -ion.

17. (a) Discuss the UV Photoelectron spectra of Nitrogen molecule.

Or

- (b) Discuss the principal applications of Auger electron spectroscopy.

18. (a) Explain ionic versus covalent bonding in metallocenes.

Or

- (b) Discuss the structural features of metal complexes with alkene and alkyne systems.

19. (a) Explain Tolman catalytic cycle and Fischer-Tropsch process.

Or

(b) Ziegler – Natta polymerization and mechanism of stereo regular polymer synthesis

20. (a) Discuss the steps in Thermometric titrations.

Or

(b) Discuss about principle and applications of spectrofluorimetry.

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(6 pages)

Reg. No. : .....

Code No. : 6409

Sub. Code : ZCHM 33

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Third Semester

Chemistry — Core

GROUP THEORY AND CHEMICAL  
THERMODYNAMICS

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

- Which of the following does not contain a  $C_3$  axis?  
(a)  $POCl_3$                       (b)  $[NH_4]^+$   
(c)  $[H_3O]^+$                       (d)  $ClF_3$
- Which molecule or ion has  $D_{3h}$  symmetry?  
(a)  $[H_3O]^+$                       (b)  $CHCl_3$   
(c)  $[CO_3]^{2-}$                       (d)  $NF_3$

3. Which of the following gives the correct description of the stretching modes of  $\text{SO}_3$ , and how many absorptions do these vibrational modes give rise to in the IR spectrum of  $\text{SO}_3$ ?
- (a) Symmetric stretch, asymmetric stretch (doubly degenerate); one absorption
  - (b) Symmetric stretch; asymmetric stretch (doubly degenerate); two absorptions
  - (c) Symmetric stretch; asymmetric stretch; two absorptions
  - (d) Symmetric stretch; asymmetric stretch; one absorption
4. The symmetric stretching mode for  $\text{PCl}_3$  is of  $A_1$  symmetry. In the  $C_{3v}$  character table, there are  $z$  and  $(x^2 + y^2, z^2)$  entries in the  $A_1$  row. this tells you that the symmetric stretching mode is \_\_\_\_\_
- (a) IR active and Raman inactive
  - (b) IR active and Raman active
  - (c) IR inactive and Raman active
  - (d) IR inactive and Raman inactive
5. Helmholtz free energy ( $A$ ) is defined as
- (a)  $A = H - TS$
  - (b)  $A = E - TS$
  - (c)  $A = H + TS$
  - (d) None of these

6. For a spontaneous process, free energy
- (a) Is zero
  - (b) Increase
  - (c) Decreases whereas the entropy increases
  - (d) And entropy both decrease
7. The Maxwell-Boltzmann law is given by the expression \_\_\_\_\_
- (a)  $1/e^{(EkT)}$
  - (b)  $1/e^{(1+EkT)}$
  - (c)  $1/e^{(\alpha+EkT)}$
  - (d)  $1/e^{(\alpha+nEkT)}$
8. Maxwell-Boltzmann statistics cannot be applied to \_\_\_\_\_
- (a) Atoms
  - (b) Molecules
  - (c) Photons
  - (d) Lattice
9. Which of the following is correct for the net entropy change in an irreversible process?
- (a) It is positive
  - (b) It is negative
  - (c) It is zero
  - (d) All of the above
10. Unfolding of regular secondary protein structure causes \_\_\_\_\_
- (a) Large decrease in the entropy of the protein
  - (b) Little increase in the entropy of protein
  - (c) No change in the entropy of the protein
  - (d) Large increase in the entropy of the protein



PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Construct a multiplication table for  $C_{3v}$  point group.

Or

- (b) Write briefly about classes of symmetry operations.

12. (a) Explain briefly about symmetry selection rule for Raman and infrared spectra.

Or

- (b) Write a note on determination of hybridization of atomic orbitals in methane.

13. (a) Write briefly about partial molar quantities and their determination.

Or

- (b) Write a note on excess thermodynamic functions.

14. (a) Write briefly about partition functions.

Or

- (b) Write briefly about negative Kelvin temperature.

15. (a) Write briefly about the Phenomenological laws and their applications in chemistry.

Or

- (b) Write briefly about application of irreversible thermodynamics to biological system.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)  
Each answer should not exceed 600 words.

16. (a) Give a detailed account on constructing character table for  $C_{4v}$  using the great orthogonality theorem.

Or

- (b) Give a detailed account on the great orthogonality theorem.

17. (a) Give a detailed account on determination of hybridization of atomic orbitals in non-linear molecule methane and  $PF_5$ .

Or

- (b) Write a note on electronic spectra of ethylene and formaldehyde.

18. (a) Discuss the significance of free energy concepts.

Or

- (b) Write a note on chemical potential and derive Gibbs - Duhem equation.

19. (a) Give the derivation of Maxwell - Boltzman statistics.

Or

- (b) Give the derivation of Maxwell - Boltzmann statistics.

20. (a) Discuss onsager reciprocal relations and application of irreversible thermodynamics to biological system.

Or

- (b) Discuss the entropy changes due to coupling of chemical reaction.
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(6 pages)

Reg. No. : .....

**Code No. : 6410**

**Sub. Code : ZCHM 34**

M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2022.

Third Semester

Chemistry — Core

SCIENTIFIC RESEARCH METHODOLOGY

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. What is the main aim of interdisciplinary research?
  - (a) To over simplify the problem of research
  - (b) To bring out the holistic approach to research
  - (c) To create a new trend in research methodology
  - (d) To reduce the emphasis on a single subject in the research domain

2. The main aim of the scientific method in the research field is to \_\_\_\_\_
  - (a) Improve data interpretation
  - (b) Confirm triangulation
  - (c) Introduce new variables
  - (d) Eliminate spurious relations
  
3. Literature is a
  - (a) Written record
  - (b) Published record
  - (c) Unpublished record
  - (d) All of these
  
4. World of learning is a what source of information
  - (a) Primary source
  - (b) Documentary source
  - (c) Secondary source
  - (d) Tertiary source
  
5. The first page of the research report is
  - (a) appendix
  - (b) bibliography
  - (c) index
  - (d) title page
  
6. The last page of the research report is
  - (a) appendix
  - (b) bibliography
  - (c) index
  - (d) title page

7. The act of presenting someone else's work or idea as own is considered as
- (a) Plagiarism
  - (b) Academic dishonesty
  - (c) Wrongful appropriation
  - (d) All of these
8. Plagiarism where the writer changes a few words in the original text of another is known as
- (a) Direct copying      (b) Word switch
  - (c) Paraphrasing      (d) None of these
9. The X-ray region stands between ultraviolet and \_\_\_\_\_ ray regions.
- (a) Gamma      (b) Alpha
  - (c) Beta      (d) UV
10. The AFM tip is typically made of \_\_\_\_\_
- (a) silicon or silicon nitride
  - (b) diamond
  - (c) silver
  - (d) graphite

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) What are the objectives of a research?

Or

- (b) What are the criteria of a good research?

12. (a) Write abbreviations of some journals.

Or

- (b) Write notes on chemical abstracts.

13. (a) Explain the types of references.

Or

- (b) What are the ways of communicating research papers?

14. (a) What is plagiarism?

Or

- (b) What is intellectual property right?

15. (a) Explain the principle, instrumentation and applications of AFM.

Or

- (b) Elucidate the principle, instrumentation and applications of scanning electron microscopy.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)  
Each answer should not exceed 600 words.

16. (a) Discuss the problems encountered by researchers in India.

Or

- (b) Explain funding agencies in India to carryout research.

17. (a) Elucidate literature survey as sources of information.

Or

- (b) Explain the significance of SCOPUS.

18. (a) Explicate format of a research report.

Or

- (b) Discuss the structure of a research paper.

19. (a) Explain IPR and LICENSING.

Or

- (b) Elucidate techniques used to avoid plagiarism.



20. (a) Explain the principle, instrumentation and applications of X-ray photoelectron spectroscopy.

Or

- (b) Enlighten the principle, instrumentation and applications of transmission electron microscopy.
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