

## FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester Integrated M.Sc Geology Degree Examination, November 2020

## BCH1C01 – General Chemistry

(2020 Admission onwards)

Time: 2 hours

Max. Marks: 60

## Section A (Short answers)

(Answer questions up to 20 marks. Each question carries 2 marks)

1. Distinguish isobars and isotones with suitable examples.
2. Define Equivalent mass of an acid and a base.
3. Explain Pauli's Exclusion principle.
4. Explain the Lattice energy of an ionic compound.
5. What is bond order? Calculate the bond order of  $N_2$ .
6. Explain wave-particle duality.
7. Calculate the de Broglie wavelength of an electron of mass  $9.1 \times 10^{-31}$  kg moving with a velocity  $6.3 \times 10^5$  m/s.
8. Give the characteristics of alpha rays.
9. Which of the following nuclides would you expect to be stable?  
(a)  ${}_9\text{Be}^{10}$       (b)  ${}_{12}\text{F}^{17}$       (c)  ${}_{12}\text{Mg}^{24}$
10. Give examples for trace metal ions.
11. Mention the differences between haemoglobin and myoglobin.
12. Explain Accuracy and Precision

[Ceiling of marks: 20]

## Section B (Paragraph)

(Answer questions up to 30 marks. Each question carries 5 marks)

13. What is double burette method of titration? What are the advantages of it ?
14. Explain the function of *complexometric indicators*.
15. Explain Quantum numbers .
16. Explain the structures of  $\text{ClF}_3$ ,  $\text{SF}_4$  and  $\text{XeF}_4$ .
17. Correlate N/P ratio and nuclear stability.
18. Explain the term Nuclear fusion with suitable example. Why fusion reactions are called thermonuclear reactions ?
19. Explain the mechanism of Sodium-Potassium pump.

[Ceiling of marks: 30]

## Section C (Essay)

(Answer any one. Each question carries 10 marks)

20. Write a note on Intermolecular forces.

21. Discuss Photosynthesis

[1 x 10 = 10 Marks]

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2020

MCH1C01- Quantum Mechanics &amp; Computational Chemistry

(2020 Admission onwards)

Time: 3 hours

Max. Weightage : 30

**Section A (Short Answer)****Answer 8 Questions out of 12.****Each question carries a weightage of 1**

- State and explain eigen value postulate of quantum mechanics.
- Which among the following function(s) is /are acceptable wave function(s) over the indicated intervals in the bracket? Explain.  
a)  $e^{-x}$   $(-\infty, \infty)$    b)  $e^{-x^2}$   $(-\infty, \infty)$    c)  $e^{|x|}$   $(-\infty, \infty)$    d)  $e^{-x} \sin x$   $(0, \infty)$
- Show that momentum operator is Hermitian.
- What are even and odd functions? Illustrate by taking SHO wave functions.
- Find the position of radial node for 2s orbital of hydrogen atom with wave function  
$$\Psi_{2s} = \frac{1}{4\sqrt{2\pi}} \left(\frac{1}{a_0}\right)^{\frac{3}{2}} (2 - \sigma)e^{-\sigma} \quad \text{where } \sigma = \frac{r}{a_0}$$
- Write Dirac's relativistic equation for hydrogen atom and explain the terms.
- Write expression for  $L_z$  and  $d\tau$  in terms of cartesian and spherical polar coordinates.
- Explain why exact solution of Schrödinger equation is impossible for an atom having more than one electron.
- Write spin orbital for helium atom based on Pauli's exclusion principle.
- Differentiate between ab initio and Molecular Mechanics methods?
- Explain semi empirical method with one example.
- Construct Z-matrix for  $\text{NH}_3$  molecule.

**(8 x 1 = 8 weightage)**



**Section B (Short Essay)**

**Answer 4 Questions out of 7.**

**Each question carries a weightage of 3**

13. Derive expression for  $\hat{L}_x$  and  $\hat{L}_y$  and evaluate the commutator  $[\hat{L}_x, \hat{L}_y]$ .
14. Sketch first three wave functions, probability densities and their energies of a simple harmonic oscillator. Discuss the difference between a quantum mechanical oscillator and a classical oscillator.
15. A photon of wave length  $4000\text{\AA}$  strikes on a metal surface of work function  $2.31\text{eV}$ . Calculate the threshold frequency, kinetic energy and velocity of emitted electron.
16. Discuss the perturbation treatment of ground state helium atom.
17. State variation theorem. Illustrate the theorem for a particle in one dimensional box using the trial function  $\phi = x(a-x)$ . Rationalize the selection of trial function.
18. What are basis sets? Discuss the classification of basis sets.
19. Explain the structure of Gaussian input file for the geometry optimization of formaldehyde molecule.

**(4 x 3 = 12 weightage)**

**Section C (Essay)**

**Answer 2 Questions out of 4.**

**Each question carries a weightage of 5**

20. Apply Schrödinger to a particle in a three dimensional box and explain the concept of degeneracy. Explain the lifting of degeneracy in cubical box by symmetry breaking.
21. Solve Schrödinger wave equation for a rigid rotor. Find eigen functions and eigen values.
22. Express Schrödinger equation for hydrogen atom in spherical polar coordinates. Separate in to R,  $\Theta$ , and  $\Phi$  equation and solve the R equation.
23. Explain Hartree's Fock self consistent field method to solve many electron atoms.

**(2 x 5 = 10 weightage)**

8

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE  
First Semester M.Sc Chemistry Degree Examination, November 2020  
MCH1C02–Chemistry of Elements  
(2020 Admission onwards)

Time: 3 hours

Max. Weightage : 30

**Section A Short Answer**  
**Answer 8 Questions out of 12.**  
**Each question carries a weightage of 1**

1. Explain HSAB principle?
2. Write the importance of the Drago-Wayland equation
3. How is  $(\text{BN})_x$  obtained from  $\text{B}_2\text{H}_6$ . Mention its uses?
4. Predict the product of the following  
$$\text{B}_5\text{H}_{11} + \text{KH} \rightarrow$$
$$\text{B}_5\text{H}_9 + \text{NMe}_3 \rightarrow$$
5. Describe the structure of sheet silicate by giving examples?
6. How isopoly anions of Molybdenum is obtained?
7. What are trans actinide elements?
8. How  $\text{S}_2\text{N}_2$  is prepared? give examples?
9. Explain critical size as applied to nuclear reaction
10. Explain Neutron activation analysis
11. What is XPS
12. What are Fullerenes?

(8 x 1 = 8 weightage)

**Section B Short Essay**  
**Answer 4 Questions out of 7.**  
**Each question carries a weightage of 3**

13. Give a brief account of precipitation reactions occurring in liquid  $\text{NH}_3$ .
14. How are substituted borazines synthesised? Give an account of their chemical reactivity?
15. What are styx numbers? Explain their uses using examples?
16. Discuss the structure of polythiazyl and tetra sulphur and tetra nitride?



17. Discuss the characteristics of Latimer diagram using Be as examples?
18. Compare and contrast the magnetic and spectral properties of lanthanide and actinides
19. Briefly explain the various methods for synthesis of nano materials?

(4 x 3 = 12 weightage)

**Section C Essay**

**Answer 2 Questions out of 4.**

**Each question carries a weightage of 5**

20. Write short notes on
  - a) Arrhenius,
  - b) Bronsted-Lowry,
  - c) Lux-Flood, Lewis and
  - d) Usanovich concepts.
21. a) Comment on the use of  $H_2SO_4$  as reaction media?  
b) How silicone are synthesised? Explain how their physical properties can be modified?
22. a) Discuss the mechanism of production of energy in the sun and stars?  
b) What is the difference between thermo nuclear and photo nuclear reactions?
23. Write short note on
  - a) Nanoelectronics
  - b) Nanosensors
  - c) Nanocatalysts
  - d) nanofiltration

(2 x 5 = 10 weightage)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2020

MCH1C03– Structure &amp; Reactivity of Organic Compounds

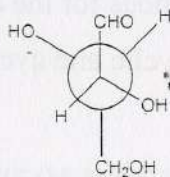
(2020 Admission onwards)

Time: 3 hours

Max. Weightage : 30

**Section A Short Answer****Answer 8 Questions out of 12.****Each question carries a weightage of 1**

1. Discuss the importance of inclusion compounds.
2. 2-hydroxy benzoic acid exist as a monomer whereas benzoic acid as dimer in non polar solvents. Why?
3. Explain Bell-Evans-Polanyi principle.
4. Explain the difference between kinetic and thermodynamic control of organic reactions?
5. Between trans-1,2-dimethylcyclohexane and its cis isomer, which one is more stable and why?
6. Draw the Newman projections of the preferred conformations of d and meso tartaric acids.
7. Discuss the stereochemical aspects of pyrolytic elimination.
8. Draw the Fischer projections of (1S,2S)-Me-CH(OH)-CHBr-Et and its enantiomer.
9. Explain why optically active biphenyl derivatives undergo racemisation on heating more easily than compounds containing asymmetric carbon.
10. Show an example where Cram's chelation control is adopted in an asymmetric synthesis.
11. Explain the use of chiral sulfoxides in asymmetric synthesis.
12. Deduce the absolute configuration of the asymmetric centres in the following molecule.

**(8 x 1 = 8 weightage)**



**Section B     Short Essay**  
**Answer 4 Questions out of 7.**  
**Each question carries a weightage of 3**

13. Discuss the aromaticity of annulenes in detail.
14. Discuss the conformational aspects of 2-bromocyclohexanone, cis & trans isomers of 2,6-dibromocyclohexanones.
15. Discuss the effect of conformation on the course and rate of reaction of semipinacolic deamination of erythro and threo 1,2-diphenyl-1-(p-chlorophenyl)-2-aminoethanol.
16. Explain the importance of conformationally biased systems in understanding the reactivity of axial and equatorial groups. Illustrate with proper reactions and examples.
17. Explain the nature of optical isomerism in the following compounds (i) hexahelicene (ii) trans-cyclooctene (iii) 2,3-pentadiene.
18. Discuss the resolution of racemic mixture by (a) conversion in to diastereoisomers and (b) chiral chromatography.
19. Explain chiral pool synthesis of beetle pheromone component (S)-(-) ipsenol from (S)- (-)leucine.

**(4 x 3 = 12 weightage)**

**Section C     Essay**  
**Answer 2 Questions out of 4.**  
**Each question carries a weightage of 5**

20. (a) Discuss how Taft equation attempts to describe the polar and steric effects in organic reactions.  
(b) Explain the MO description of aromaticity and antiaromaticity with suitable examples.
21. (a) Compare the rate of esterification of menthol, isomenthol, neomenthol and neoisomenthol explaining the conformational aspects.  
(b) Effect of conformation on elimination reaction of menthyl and neomenthyl chlorides.
22. Explain five different methods for the determination of configuration of geometrical isomers in acyclic and cyclic systems.
23. Explain  
(a) Stereochemistry of Sharpless asymmetric epoxidation reaction.  
(b) Diastereoselective asymmetric aldol reaction and its explanation by Zimmermann Traxler model.

**(2 x 5 = 10 weightage)**

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Chemistry Degree Examination, November 2020

MCH1C04– Thermodynamic Kinetic & Catalysis

(2020 Admission onwards)

Time: 3 hours

Max. Weightage : 30

**Section A (Short Answer)**

**Answer 8 Questions out of 12.**

**Each question carries a weightage of 1**

1. What is meant by residual entropy? Calculate the residual entropy of  $H_2O$  molecule.
2. What are the Hinshelwood modifications to Lindemann's unimolecular theory?
3. Derive an equation to show the variation of chemical potential with temperature
4. Explain the Nernst heat theorem and its significance.
5. Show that Freundlich adsorption isotherm is a special case of Langmuir adsorption isotherm.
6. Write the Glansdorf-Pregogine equation and explain the terms.
7. Explain the Flash photolysis method for the measurement of kinetics of fast reactions.
8. Explain the material balance equation.
9. What is meant by excess entropy?
10. Explain autocatalysis with an example.
11. Explain any two methods for the preparation of zeolites.
12. Explain two methods for the determination of pore size of adsorbents.

**(8 x 1 = 8 weightage)**

**Section B (Short Essay)**

**Answer 4 Questions out of 7.**

**Each question carries a weightage of 3**

13. Explain the mechanism of thermal diffusion and thermo-osmosis.
14. What is meant by surface acidity? Explain the TPD method of determination
15. Explain Langmuir-Hinshelwood mechanism of the bimolecular surface reaction.



16. Write the Bronstead -Bjerrum equation, explain the terms and illustrate the various salt effects.
17. Explain the Rice-Herzfeld mechanism for deriving the rate equation for the organic decomposition reaction of acetaldehyde.
18. Derive Gibb's- Duhem equation and explain its' applications.
19. Illustrate the Eley-Rideal mechanism using the reaction  $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$ .

(4 x 3 = 12 weightage)

### Section C Essay

Answer 2 Questions out of 4.

Each question carries a weightage of 5

20. Derive Duhem-Margules equation and explain its application.
21. Explain the mechanism of Oscillatory reactions using Lotka-Volterra and Brusselator mechanism.
22. What are branching chain reactions? Explain the explosion limits using  $\text{H}_2\text{-O}_2$  reaction as an example.
23. Derive BET equation and explain its application in calculating the surface area of solids.

(2 x 5 = 10 weightage)