

Five Year Integrated M.Sc. Examination, 2019

Semester - VIII

Paper: CH-4-8-1

(Molecules to Materials, Asymmetric Synthesis, Green Chemistry, Symmetry and Group Theory)

Time: Four Hours

Full Marks: 80

Questions are of value as indicated in the margin.

Group-A

1. Answer *any ten* questions: 10x2
- What is Ferrimagnetism?
 - Define and illustrate Gauss's law.
 - Calculate the magnetic moment of $\text{Gd}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$.
 - What is hysteresis loss?
 - Name the point symmetry group of NH_3 molecule and arrange the symmetry operations according to the class.
 - What do you mean by an abelian group? Give one example of such a group.
 - Write down the criterion for irreducibility of a representation of a point symmetry group.
 - How many different irreducible representations there are for C_{3v} point symmetry group?
 - Explain the stereospecific reaction with a suitable example.
 - Give examples of two alternate reaction media in terms of green approach.
 - Write two difference between conventional heating with microwave heating.
 - Why chiral catalyst is better than chiral auxiliary?

Group-B

Answer *any two* questions.

2. 4
- Discuss orbital contribution in magnetic materials. 2
 - Give significance of Neel temperature. 2
 - Calculate the spin only and spin plus orbital magnetic moments of $[\text{CrCl}_6]^{3-}$. 2
 - Comment on the magnetic behavior of Sm^{3+} at room temperature. 2
3. 4
- Discuss with example super-exchange behavior in magnetic systems. 4
 - Match column A with column B with proper justification for matching each pair. 6

Column A	Column B
$[\text{Co}(\text{H}_2\text{O})_6]\text{SO}_4$	Antiferromagnetic
$[\text{Cu}(\text{CH}_3\text{COOH})_2 \cdot \text{H}_2\text{O}]$	Paramagnetic
$[\text{Ru}(\text{H}_2\text{O})_6]^{2+}$	$\mu_{\text{obs}} > 4.1 \text{ BM}$
	Diamagnetic

4. 3
- Justify: Canted magnetism always leads to a weak ferromagnetism. 3
 - Explain the terms: Saturation magnetization, remanent magnetization and coercive field in ferromagnetic materials. 4
 - Make a comparison between soft and hard ferromagnetic materials. 3

Group-C

Answer *any two* questions.

5. 3+3
- Write down the great orthogonality theorem and explain the different terms in it. Hence obtain the orthogonality theorem in terms of characters. 3+3
 - Find out an expression for the number of times an irreducible representation occurs in a given reducible representation in terms of the characters of the symmetry operations. 4

P.T.O.

(2)

6. Consider the C_{2v} character table given below. Using this table classify the normal modes of vibration of trans- H_2O molecule according to symmetry. Using group theory explain which of these normal modes are infrared and Raman active. 10

C_{2v}	E	C_2	$\sigma_v(xz)$	$\sigma_v(yz)$		
A_1	1	1	1	1	z, x^2, y^2, z^2	
A_2	1	1	-1	-1	R_z, xy	
B_1	1	-1	1	-1	x, R_y, xz	
B_2	1	-1	-1	1	y, R_x, yz	

Hint: For every unmoved nucleus as a result of R use the results.

R	E	$C(\theta)$	σ	$S(\theta)$
$\chi(R)$	3	$1+2 \cos \theta$	1	$-1+2\cos \theta$

7. a) Using the 's' orbitals of three hydrogen and nitrogen atoms of NH_3 molecule construct the matrix representations of different symmetry operations of NH_3 molecule. 5
 b) Using the theorems of irreducible representation construct the character table of C_{3v} point symmetry group. 5

Group-D

Answer *any two* questions.

8. a) What do you mean by (%) of atom economy of a chemical reaction?
 Calculate the (%) of atom economy of the following reactions: 2+3
 $CH_3COOCH_3 + H_2O \rightarrow CH_2OH + CH_3COOH$
 b) Discuss the basic structure of ionic liquid and give the preparation of any one of them. 1+2
 c) Friedel Craft acylation reaction is a very good conversion in terms of preparative purpose but not in terms of green chemistry. Explain this observation using the concept of turn over number (TON). 2
9. a) Outline the synthesis of Ibuprofen by BOOTS and BHC companies. Which one is more green and why? 2+3+1
 b) Write short notes on (any one) (i) Multi component Reactions, (ii) Microwaves in organic synthesis. 4
10. a) Outline the synthesis and give an application of the Evans' chiral auxiliary in asymmetric synthesis with proper mechanism. 2+3
 b) What is the structure of C-B-S chiral catalyst? Using this catalyst synthesize an asymmetric molecule of your choice. 1+2
 c) Will you consider the inversion of stereochemistry in SN^2 reaction? 1+1