



CHE-501
M.Sc. 1st SEMESTER EXAMINATION, 2021-22
Chemistry
(Molecular Symmetry and Molecular Vibration)
Credit (4+0)
(CBCS Mode)

<u>Important Instruction :</u>	<u>महत्वपूर्ण निर्देश :</u>
The question paper is in two sections : Section-A (Descriptive) will be of 15 marks and Section-B (Objective) will be of 60 marks. Section-A will be deposited at the end of the examination and answer sheet (OMR) of Section-B will be deposited.	प्रश्न पत्र दो भागों में है : खण्ड-अ (व्याख्यात्मक) 15 अंकों का होगा एवं खण्ड-ब (बहुविकल्पीय) 60 अंकों का होगा। खण्ड-अ परीक्षा के अन्त में जमा कर लिया जायेगा एवं खण्ड-ब का उत्तर पत्रिका (OMR) जमा होगा।

खण्ड-अ (व्याख्यात्मक)
Section-A (Descriptive)

Time : 1 Hrs.
समय : 1 घण्टे

Max. Marks : 15
अधिकतम अंक : 15

अनुक्रमांक (अंकों में) :

Roll No. (In Figures)

अनुक्रमांक (शब्दों में) :

Roll No. (In Words) :

अभ्यर्थी का नाम :

Student Name :

कक्ष परिप्रेक्षक के हस्ताक्षर / Invigilator's Signature :

- Note : (i) Total No. of Questions are Six.
(ii) Answer three questions in all.
(iii) All Questions carry equal marks.
- नोट : (i) कुल छः प्रश्न दिए गये हैं।
(ii) किन्हीं तीन प्रश्नों के उत्तर दीजिए।
(iii) सभी प्रश्नों के अंक समान हैं।

1. Define the term 'point group. Identify the point group of "trans-1,2 dichloroethylene" and deduce the symmetry operations.
2. Derive the character table for C_{3v} point group.
3. Construct group multiplication table. for point group and find out whether or not the group is Abelian.
4. Discuss "The great Orthogonality Theorem".
5. Find out the fundamental vibrational modes of vibration of NH_3 by Cartesian coordinate method.
6. Write short notes on :
 - (a) Cubic point group
 - (b) Cyclic group

खण्ड-ब (बहुविकल्पीय)

Section-B (Objective)

CHE-501

M.Sc. 1st Semester Examination, 2021-22

CHEMISTRY

(Molecular Symmetry and Molecular Vibration)

Credit (4+0)

(CBCS Mode)

AFFIX PRESCRIBED
RUBBER STAMP

Paper ID

(To be filled in the
OMR Sheet)

Date (तिथि) : _____

0183

अनुक्रमांक (अंकों में) :

Roll No. (In Figures)

अनुक्रमांक (शब्दों में) : _____

Roll No. (In Words) : _____

Time : 1½ Hrs.

समय : 1½ घण्टे

Max. Marks : 60

अधिकतम अंक : 60

नोट : पुस्तिका में 40 प्रश्न दिये गये हैं, सभी प्रश्न करने होंगे। प्रत्येक प्रश्न 1.5 अंक का होगा।

Important Instructions :

1. The candidate will write his/her Roll Number only at the places provided for, i.e. on the cover page and on the OMR answer sheet at the end and nowhere else.
2. Immediately on receipt of the question booklet, the candidate should check up the booklet and ensure that it contains all the pages and that no question is missing. If the candidate finds any discrepancy in the question booklet, he/she should report the invigilator within 10 minutes of the issue of this booklet and a fresh question booklet without any discrepancy be obtained.

महत्वपूर्ण निर्देश :

1. अभ्यर्थी अपने अनुक्रमांक केवल उन्हीं स्थानों पर लिखेंगे जो इसके लिए दिये गये हैं, अर्थात् प्रश्न पुस्तिका के मुख्य पृष्ठ तथा साथ दिये गये ओ०एम०आर० उत्तर पत्र पर, तथा अन्यत्र कहीं नहीं लिखेंगे।
2. प्रश्न पुस्तिका मिलते ही अभ्यर्थी को जाँच करके सुनिश्चित कर लेना चाहिए कि इस पुस्तिका में पूरे पृष्ठ हैं और कोई प्रश्न छूटा तो नहीं है। यदि कोई विसंगति है तो प्रश्न पुस्तिका मिलने के 10 मिनट के भीतर ही कक्ष परिप्रेक्षक को सूचित करना चाहिए और बिना त्रुटि की दूसरी प्रश्न पुस्तिका प्राप्त कर लेना चाहिए।

1. Which of the following is an operation ?
 - (A) Matrix
 - (B) Axis
 - (C) Rotation
 - (D) None of these
2. The order of T point group is.
 - (A) 4
 - (B) 15
 - (C) 12
 - (D) 16
3. Number of C_3 present in tetrahedral molecule is :
 - (A) 4
 - (B) 3
 - (C) 6
 - (D) 2
4. The point group of staggered ethane is:
 - (A) D_3
 - (B) D_{3h}
 - (C) C_{3v}
 - (D) D_{3d}
5. C_{2h} point group is isomorphic with:
 - (A) C_{2v}
 - (B) S_4
 - (C) C_{4v}
 - (D) C_{3v}

6. The number of planes present in I_n point group is:
- (A) 6
 - (B) 8
 - (C) 15
 - (D) None of these
7. In T_{2g} , g represents:
- (A) E
 - (B) σ
 - (C) i
 - (D) All of these
8. $\sigma_{xz} \sigma_{yz}$ equals-
- (A) E
 - (B) $C_{2(z)}$
 - (C) i
 - (D) None of these
9. Bcl_3 is an example of point group?
- (A) D_{3h}
 - (B) C_{3h}
 - (C) C_{3v}
 - (D) None of these
10. Point group assigned to a circle is:
- (A) C_{2v}
 - (B) $D_{\infty h}$
 - (C) $C_{\infty v}$
 - (D) None of these

11. In the GMT of order 3 if we follow $AA = E$ or $AA = B$, this the correct features-
- (A) Column will not follow rearrangement theorem
 - (B) Each Column is headed with one element so of each row
 - (C) Only (A) is correct
 - (D) (A) and (B) both are correct
12. Following rule is three for mutual conjugation-
- (A) $A = X^{-1}BX$ and $B = Y^{-1}AY$
 - (B) $B = X^{-1}AX$
 - (C) $X^{-1}AX = B$ and $Y^{-1}AY = C$
 - (D) All are incorrect
13. Class will follow rules:
- (A) Similar σ_v similar σ_d are in one class
 - (B) S_n^m axis like C_n^m are in a class
 - (C) E is not a class
 - (D) σ_n is not special class but falls in σ_v and σ_d
14. In the character table, true statement is:
- (A) Area I, deals with the character of IR_s
 - (B) Area III represents translational and rotational motions
 - (C) Area II represents the Milliken symbols
 - (D) All are correct
15. For IR activity for a molecule, one should follow:
- (A) $\left(\frac{S_{ui}}{S\theta}\right)_0 = 0$
 - (B) $\left(\frac{S_{ui}}{S\theta}\right)_0 \neq 0$
 - (C) $\left(\frac{S_{ui}}{S\theta}\right) \neq 0$
 - (D) $\left(\frac{S_{ui}}{S\theta}\right) = 0$

16. Among the three modes in H_2O molecule:
- (A) All are stretching modes
 - (B) All are bending modes
 - (C) B_2 is pure stretching mode
 - (D) B_2 is pure bending mode
17. What will be the value of $A_2 \times E$ for C_{3v} point group.
- (A) A_2
 - (B) $A_1 + A_2$
 - (C) E
 - (D) A_1
18. Among the following which is trivial group.
- (A) C_5
 - (B) C_3
 - (C) C_1
 - (D) C_i
19. True statement for subgroup:
- (A) Subgroup are of two types
 - (B) Subgroup satisfy the rule $h/g = k$
 - (C) (A) and (B) both are correct
 - (D) Only (A) is correct
20. In the character table of C_{3v} point group R_2 falls in:
- (A) A_2
 - (B) A_1
 - (C) E
 - (D) Does not exist

21. How many proper axis of rotation are present in T_d point group?
- (A) $6 C_3, 3 C_2$
 - (B) $8 C_3, 3 C_2$
 - (C) $8 C_3, 6 C_2$
 - (D) $6 C_3, 6 C_2$
22. C_n will show.
- (A) 2_n operation
 - (B) $n/2$ operation
 - (C) n operation
 - (D) None of these
23. D_n point is isomorphic group to:
- (A) C_n
 - (B) C_{nv}
 - (C) C_{2h}
 - (D) S_n
24. How many sub-group will be in D_{3h} point group.
- (A) 4
 - (B) 8
 - (C) 7
 - (D) 5
25. C_{2v} point group is:
- (A) Abelian and non-cyclic
 - (B) Cyclic and non-abelian
 - (C) Non- Abelian
 - (D) Cyclic and Abelian

26. $(C_5H_5)_2 Fe$ will have point group-
- (A) D_{5h}
 - (B) D_{5d}
 - (C) D_{4h}
 - (D) D_{4d}
27. In the following molecules, which has improper axis of rotation?
- (A) NH_3
 - (B) Ethane (eclipsed)
 - (C) AB_5 type
 - (D) All are correct
28. Among the following inversion operation is not present in:
- (A) 1, 2 - dichloro - 1, 2- dibromoethane (trans)
 - (B) 1, 2- dichloro - 1,2 - dibromoethane (Staggered)
 - (C) P_2F_5
 - (D) P_2F_4
29. In $P+Cl_4^{2-}$ molecule, planes are:
- (A) $4\sigma_v$
 - (B) $4\sigma_d$
 - (C) $2\sigma_v 2\sigma_d$
 - (D) $2\sigma_d 2\sigma_h$
30. Binomial function in any character table is placed in:
- (A) Area III
 - (B) Area I
 - (C) Area II
 - (D) Area IV

31. In cyclic group, all the multiplication are-
- (A) Non-Commutative
 - (B) Commutative
 - (C) Abelian
 - (D) Conjugate
32. Which statement is not correct for similarity transform?
- (A) Every element is conjugate with itself
 - (B) If A is conjugate with B then B is conjugate with A
 - (C) Every element is non-conjugate with itself
 - (D) If A is conjugate with B and C, then B and C conjugate with each other
33. Which is the correct formula for subgroup?
- (A) $h/g = k$
 - (B) $g/h = k$
 - (C) $h/g = 0$
 - (D) $g/h = 0$
34. How many modes of vibration in CO_2 molecules?
- (A) 4
 - (B) 3
 - (C) 2
 - (D) 5
35. Number of bending modes for NH_3 molecules-
- (A) $2A_1 + 2E$
 - (B) $2A_1$
 - (C) $2E$
 - (D) $A_1 + E$

36. Stretching modes of H_2O molecule are-
- (A) $2B_2$
 - (B) $2A_1$
 - (C) $A_1 + B_2$
 - (D) None of them
37. Which is not correct for "Rearrangement Theorem"?
- (A) Each row and each column in GMT lists each of the group elements once and only once
 - (B) No two rows may be identical
 - (C) Two columns may be identical
 - (D) Each column is headed by one element and so of each row
38. True statement for group-
- (A) One element in the group commute with each other.
 - (B) Every element may have a reciprocal which is also an element of the group
 - (C) Group does not hold associative law
 - (D) The product of any two elements may not be an element of the group
39. IR and Raman activity for 'E' mode of NH_3 molecule is-
- (A) IR active, Raman inactive
 - (B) IR inactive, Raman active
 - (C) IR and Raman Inactive
 - (D) IR and Raman active
40. R_x and R_y rotation in C_{3v} character table falls in:
- (A) A_1
 - (B) B_2
 - (C) E
 - (D) B_1
